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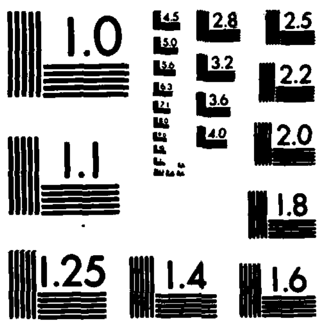

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CR-1-1091

AIRWAR II User's Manual

by
J.L. Hertel
K.E. Moore

17 April 1984

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GENERAL RESEARCH CORPORATION
P.O. BOX 6770, SANTA BARBARA, CALIFORNIA 93160-6770

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ILLUSTRATIONS

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1 INTRODUCTION

The AIRWARII model was developed under the auspices of the Aeronautical Systems Division of USAF/AFSC for use in evaluating the effectiveness of competing aircraft designs in an extended air-to-air and air-to-ground campaign. The model is a significant enhancement of General Research Corporation's model AIRWAR. AIRWAR has been used in a number of analyses, including the Advanced Counterair Engagement Mission Analysis (ACEMA) for the Aeronautical Systems Division/Deputy for Development Planning (ASD/XR) in 1981. AIRWARII is to be installed on the CDC computer at ASD/AD in March 1984.

AIRWARII is a deterministic, expected-value, event based simulation of a two-sided air-to-air and air-to-ground campaign fought over an extended period of time. The basic scenario is that two adversary Air Forces attempt to destroy their opponent's airfields while defending their own.

The campaign begins with an attack by one of the forces, and ends at a time specified by the user. Attrition of the major fighting units, aircraft, SAMs, and runways, is determined by expected-value methods.

This model is helpful in determining sensitivities to "macro" parameters. For example, to determine the effect of an improved radar, one does not input range, radar cross section, etc. Instead, one determines (outside the model) the effect of these parameters on a macro parameter such as Probability of Detection and Conversion, and then adjusts the input value of this variable. Anticipated results could be differences in exchange ratios, sortie rates, etc. The advantages of a high-level model like AIRWARII are relatively short run time and ease of operation as compared with detailed low-level simulation.

The purpose of this User's Manual is to provide non-programming users with the information needed to use AIRWARII. Section 2 of this manual describes the physical system being modeled. Section 3 is an overall description of AIRWARII. Section 4 details AIRWARII inputs and execution instructions. Section 5 describes the output options.

2 PHYSICAL SYSTEM BEING MODELED

2.1 INTRODUCTION

Program AIRWARII is a deterministic, expected-value model of an extended, two-sided, air-to-air/air-to-ground campaign. No random numbers are used. Instead, expected values are calculated and integrated numerically, providing the user with gross effects of various parameter changes on the outcome of an extended campaign. The following section describes the campaign.

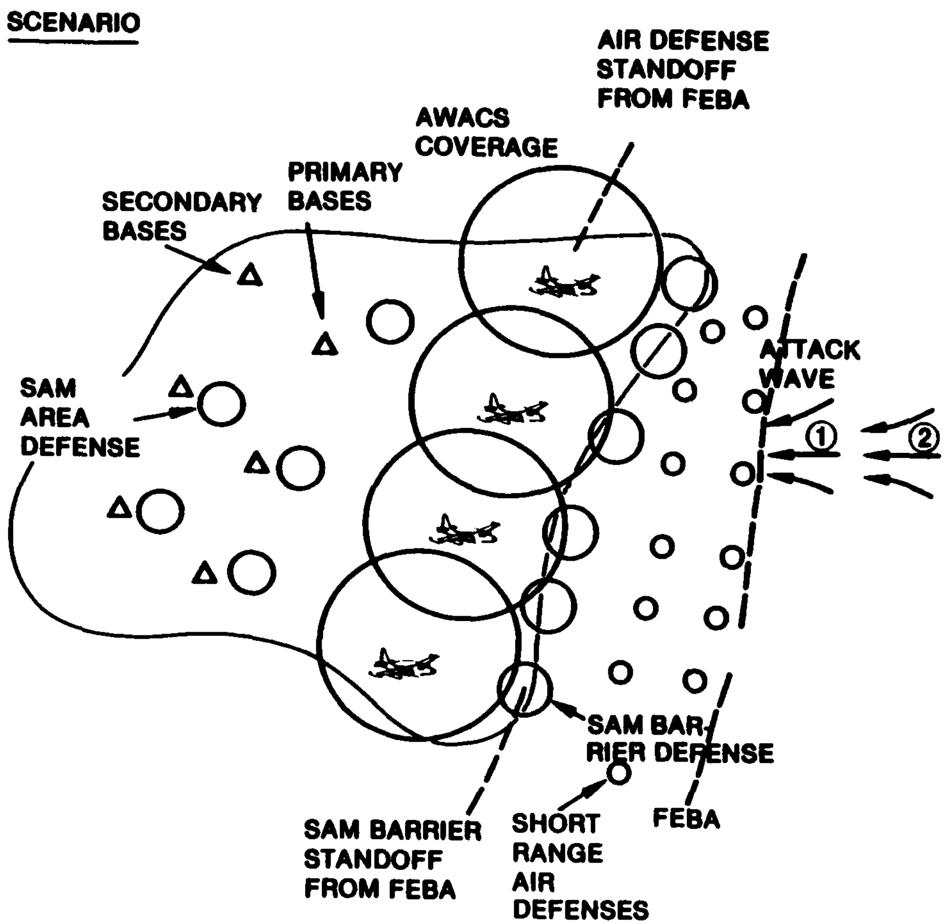
2.2 GENERAL SCENARIO

In a typical AIRWARII scenario (see Figure 2.1), two adversary Air Forces engage in an extended campaign. The campaign begins when one force attacks the other's airbases, while the other defends itself. As the campaign continues, each side may play both attacker and defender. Broken and damaged airplanes are continuously repaired, as are runways. Additionally, at various user-specified times throughout the campaign, reinforcements of aircraft, supplies for sorties, and SAMs may occur. The campaign ends at a time specified by the user.

An attacking force, which may consist of up to six types of aircraft, heads for the Forward Edge of the Battle Area (FEBA). By the time the force arrives at the FEBA, some of the aircraft have suffered system failures requiring them to return to their bases for recovery. The remaining force crosses the FEBA, entering hostile territory.

When attackers penetrate the defenders' territory, defenders launch up to five types of Air Interceptor (AI). Some of these AIs fail enroute and must return to their bases for recovery.

The first attackers to enter defender territory are SAM suppression (Wild Weasel) aircraft. They attempt to punch holes in the



GENERAL FEATURES

- FULLY TWO-SIDED
- MULTI-WAVE ATTACKS
- MULTIPLE AIRCRAFT TYPES AND WEAPONS
- COUNTERS/TACTICS
- WEAPON DELIVERY
- SAM BARRIER AND TERMINAL DEFENSE

OUTPUTS:

- NUMBER OF BLUE/RED AIRCRAFT KILLED BY TYPE
- NUMBER OF WEAPONS DELIVERED
- TABULAR AND/OR GRAPHIC

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Figure 2.1. AIRWARII - Air-To-Air Combat Model

three ground-based air defense zones: Short Range Air Defenses (SHORAD), Barrier SAMs (BSAM), and terminal, or Area dispersed SAMs (ASAM). The air defenses, meanwhile, try to punch holes in the Wild Weasels.

The rest of the attack force follows the Wild Weasel force through the SHORAD and BSAM zones. Aircraft attrition will increase as the attackers penetrate further into these zones.

Those attacking aircraft that neither break down nor get shot down enter the AI zone of defense. Here they meet the defending AIs that haven't broken down. An air battle ensues. The remaining attackers then continue toward the defenders' bases.

Enroute to the defenders' bases, the attackers must pass through the ASAM zone. Surviving this, they then reach their maximum penetration distance, have presumably dropped their bombs, and subsequently turn and head for home. If a range is specified by the user, bombs could have been dropped at any point beyond the FEBA (implying standoff ground attack weapons), the aircraft then penetrating less and thus not encountering all zones of defense.

When the bombs cease to fall, the defending force returns to base and is recovered. At some point after this, the attacker is also recovered. At this point, either side is free to mount an attack. Upon recovery, aircraft are placed into various queues, depending upon their state of disrepair. These queues operate continuously throughout the campaign, as does runway repair.

At any user-specified time during the campaign, reinforcement events can occur. These reinforcement events may be for aircraft, sortie supplies, and SAMs.

The general scenario outlined above is an account of AIRWARII at capacity and in the venue for which it was created. With careful selection of input, runs may also be made to simulate fighter sweeps, attacks on sites other than airbases, or counterair campaigns. There are, of course, many variations on the theme. These variations will become more apparent as the user becomes familiar with the model.

3 MODEL DESCRIPTION

The following description is not intended for the programmer wishing to make changes in the code of AIRWARII. It outlines AIRWARII'S basic logic flow, its strengths and limits, its flexibility and constraints, to give the user greater latitude in implementation and an increased understanding of output when utilizing AIRWARII.

Section 3.1 describes in detail the major events and subevents of AIRWARII. Section 3.2 presents the program flow and some decision-making logic. Section 3.3 lists the inherent limitations of AIRWARII as well as supplying helpful hints and cautions.

3.1 AIRWARII EVENTS

AIRWARII has two classes of events: those that are user-specified and those that are intrinsic to most AIRWARII runs. In the first class are the attack and reinforcement events. In the second are events such as a battle, recovery, air engagement, etc. Output may be obtained for all except ground operations.

There are four user-specified events:

LAUNCH ATTACK. The first attack launch starts the war. In any launch event, the user has specified the time of launch and both the desired and minimum number of aircraft required for each type of aircraft. If the user has both primary and secondary airfields containing aircraft of a specific type, the number launched from by each type of airfield is proportional to the original ratio of aircraft assigned to primary and secondary airfields.

However, as the campaign progresses, some bases may be closed, and the ratio of aircraft assigned to primary and secondary bases may not be the same as the original allocation. Therefore, if the desired raid size cannot be met by the original allocation, there is

an attempt to launch ready aircraft from any open base. This attempt to meet the desired raid size continues until:

- The desired raid size is met;
- The minimum raid size is met (but not the desired raid size) and there are no remaining aircraft available; or
- The minimum raid size is not met and there are no remaining aircraft available.

In case 1 or 2, the launch is successful, while case 3 results in an aborted launch. In the event of an abort, the attacker must wait until his next user-scheduled attack.

REINFORCE AIRCRAFT. Aircraft reinforcements are defined as a number of fresh aircraft available for assignment to a side's bases. Either side may schedule reinforcement of any aircraft type in any amount at any time.

Aircraft and sortie supplies are delivered to bases in separate reinforcement events, but follow the same allocation scheme dependent upon secondary bases operating at a fractional level of the capability of primary bases (FOP). Each aircraft type may be stationed at primary bases, secondary bases, or both.

If bombing has closed primary bases while secondary bases remain open, all reinforcements are sent to the secondaries. The reverse is true if secondaries close and primaries remain open.

Should both primary and secondary bases be closed, each would receive a fraction of the allocation determined by FOP with the hope that they would soon reopen. When both primary and secondary bases remain operational, allocation delivers reinforcements where the maximum number of sorties can be generated, giving the other base type any residual.

REINFORCE SORTIE SUPPLIES. Supply reinforcements are defined by the maximum number of sorties (of a stated type of aircraft) they will support. Although supplies would include fuel, weapons, parts, and men, AIRWARII considers these as an aggregate; the ability to generate a sortie.

These may be scheduled for either side in support of any type of aircraft at any time. The same allocation scheme detailed for aircraft reinforcement applies to supplies.

REINFORCE SAM SUPPLIES. SAM reinforcement is defined by the delivery of a specified number of missiles to each launch vehicle of each type within a defense area. These may be scheduled at any time by either side.

There are four main events which are intrinsic to most AIRWARII scenarios, with sub-events within them. These four intrinsic events are:

DEFENDER LAUNCH. A defender launch occurs when the attacking force reaches the FEBA. The defender attempts to launch a number of AIs which is a specified ratio (defenders/attackers) of the attacking force. If the defending force has primary and secondary airfields, AIs are first launched from each type of open airfield in proportion to their initial allocation. If this sum should should fail to meet the required number, additional aircraft are launched from the open airfields until the required number is met or there are no available aircraft remaining.

BATTLE. A battle results when attacking aircraft violate a defender's airspace by crossing the FEBA. The events that occur within a battle are described below. These events, with the exception of the bombing event, occur in the order listed. The bombing event may be concurrent with any of the other battle events.

An event will not occur for a specific aircraft until it penetrates to the standoff distance of the corresponding air defenses.

SAM Weasel. This initial event simulates the suppression of air defenses by Wild Weasel aircraft. The Weasels attack a certain fraction of the air defenses, in effect opening a corridor for the remaining attackers. Weasels are progressively eliminated by SAMs as they enter each successive air defense zone.

SHORAD. This event simulates the attrition of attacking aircraft by short-range air defenses. These defenses, located near the FEBA, are dispersed according to an input of sites/nm^2 within the area defined by the SHORAD standoff distance and that of the next defensive zone (usually BSAM). The further the aircraft penetrate into this zone, the more SHORAD sites they encounter.

As each SHORAD site is encountered, aircraft are attrited. Thus, those SHORAD sites close to the next defensive zone have more salvos per aircraft than those close to the FEBA. As each successive salvo is fired, the supply of salvos per launch vehicle is diminished.

BSAM. The barrier SAM zone is typically bounded by the SHORAD and AI defense zones. Barrier SAMs are deployed in a single line parallel to the FEBA. The depth of the BSAM zone is twice the maximum kill radius. Fired salvos deplete the supply of salvos per launch vehicle.

AI. In this zone, the Air Intercept zone, attacking aircraft are intercepted by the defender's AIs. Fractricide may also occur. Aircraft are evenly dispersed throughout the zone by type according to the fraction of their side's total force arriving at the zone.

These dispersed groups of opposing forces then encounter each other. It is assumed that aircraft with salvos fire all salvos unless they fail to detect and convert.

The battle in each group continues until there is a complete lack of either opposition or salvos.

ASAM. Here the terminal air defenses are located. This zone is typically located between the AI zone and the defenders' bases. It is identical in execution to the SHORAD zone. See b.

Bombing. Bombs can be dropped anywhere within the defender's territory. Bombs are assumed to be dropped on airbases, except as explained in Sec. 4.2.5.1. The user specifies the beginning and end points of the section of defender's territory where bombs are to be dropped. The end point of this section is assumed to be the maximum penetration distance of the attacker. This section is divided into ten increments, with a specified fraction of ground attack weapons delivered in each increment. This

allows the user to implicitly specify various ranges for the weapons carried. Only those aircraft alive at an increment may deliver bombs. Any fraction of bombs not assigned by the user to runways or shelters may be assumed to be dropped on alternate ground targets. However, the program does not tabulate damage to those alternate ground targets.

Bombs eliminate runways in the following manner: A runway of X length, with an aircraft type requiring some take-off length T, has N number of take-off lengths for this aircraft type. The total number of take-off lengths available to this aircraft type is the product of N and the number of runways. When bombs are dropped, the product of the number of bombs dropped and the bomb P_k determines the number of take-off lengths killed. This is done for each aircraft type.

RECOVERY. Recovery events occur after every launch and every battle for both offensive and defensive aircraft at primary and secondary airfields. Recovery events after launches are "Early Recovery" events, while those occurring after battles are "Recovery" events. Dependent upon user inputs, failed aircraft are placed in "broken queues"; aircraft damaged in battle but not killed are placed in "damaged queues", those damaged beyond repair but still arriving at an airbase are considered killed; and those remaining are placed in the "reserve queue".

During a recovery event, an attempt is made to allocate aircraft to primary and secondary airfields in the ratio specified at the game start. If primary airfields are destroyed beyond a user-specified fraction, aircraft land at secondary airfields.

If secondary airfields are closed, aircraft will land at primary airfields. If both airfields are closed, aircraft are unable to land and are therefore out of the game.

GROUND OPERATIONS. This event consists of updating the various queues and runway repair at every time step during program operation. Unlike the other major events, no output is generated for this event. The updating of queues consists of a transfer of aircraft from one queue to another at specified rates. Aircraft from the "damaged" queue fill the "damage repair" queue to capacity or less, aircraft from the "broken" queue fill the "broken repair" queue to an input capacity or less, and repaired aircraft are routed to the "reserve" queue. Reserve aircraft fill the "turnaround" queue to capacity or less, while aircraft turned around are placed in the "ready" queue. Meanwhile, runway repair is updated according to an exponential time curve until completed. All ground operations may be impaired by nuclear/chemical/biological weapons.

3.2 AIRWARII PROGRAM FLOW

A logical flowchart of AIRWARII is given in Fig. 3.1. Names of routines in the program which correspond to portions of the logic flow are shown to the left of the chart. A brief narrative description, corresponding to the logical flowchart, follows. More detailed operational flowcharts are in Appendix A.

The main program AIRWAR reads as input the number of cases to be processed. It calls subroutine READIT to read all namelists, initialize values, schedule attack and reinforcement events, and initialize ground maintenance queues and operating parameters. Program AIRWAR then prints the original status of Red and Blue and advances game time by DT.

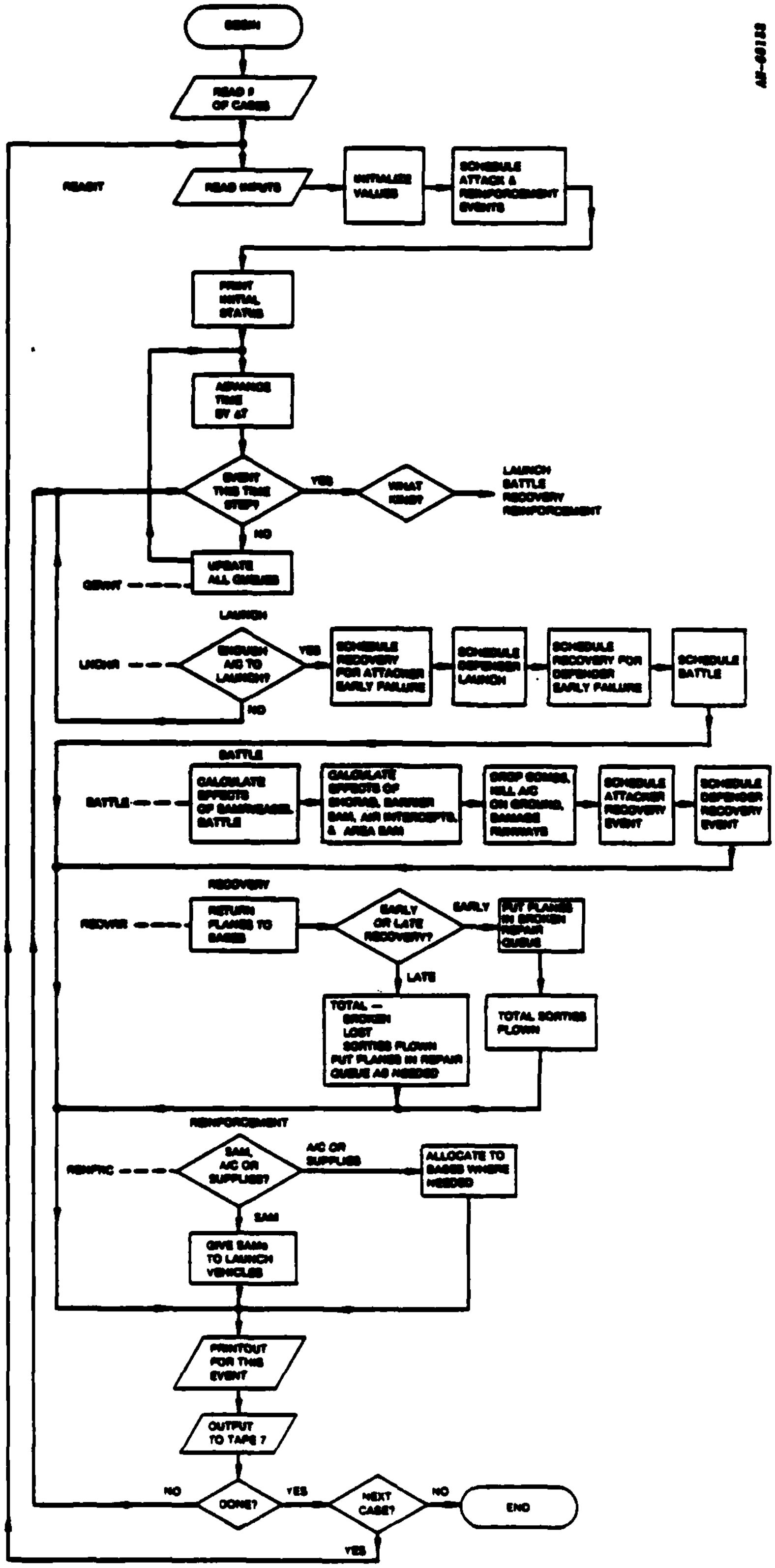

Figure 3.1. AIRWARII Flowchart

If no event has occurred within this time step, subroutine QEVNT updates all aircraft repair and turnaround queues and returns control to AIRWAR, which again advances one time step. If, however, an event in the list held by routine LISTUP has occurred, action passes to the proper routines to enact that event. The four events possible are as follows:

Launch Aircraft. Subroutine LNCHR attempts to gather sufficient force from both primary and secondary air fields in order to launch an attack. If the attempt fails, the launch is aborted and control returns to AIRWAR. If it succeeds, LNCHR launches an attack. Additionally, it schedules an early recovery for that portion of the force that fails enroute to the battle. Following this, LNCHR schedules a defender launch to meet the attack in addition to a battle event between forces. Subroutine LNCHR also launches the defender when its event time arrives and schedules an early recovery for failed defender's planes.

Battle. Subroutine BATTLE stages the confrontation of attacker and defender. First a SAM versus Weasel battle depletes SAMs and Weasels. Then SAMs are fired from SHORAD and BSAM zones at the attacking aircraft. In the air intercept zone, Red and Blue aircraft fight each other. Next, SAMs are launched at attackers from the area defense zone. Surviving attacker aircraft drop bombs using routine DROPEM before returning home.

Subroutine BATTLE schedules post-battle recovery events (called late recoveries) for both attacker and defender.

Recovery. Subroutine RECVRR returns a designated group of planes to their bases. For an early recovery (aircraft failing enroute to their mission) RECVRR places planes in the "broken repair" queue. For a late recovery, RECVRR evaluates the numbers of broken, damaged, and lost planes, which are accounted for and sent to the proper queues.

The number of sorties flown is incremented for all planes, even if damaged or lost.

Reinforcement. Subroutine RENFRC handles aircraft, supply, and SAM reinforcements. SAMs are given to the designated launch vehicles by type and zone. Aircraft and supplies are allocated to primary and secondary bases in an attempt to maximize the number of sorties flown (see Appendix A, Fig. A.2 for detailed allocation).

All of these branches return to program AIRWAR to print output reflecting the event and to write data on the graphics display file.

Program AIRWAR checks LISTUP to see if any more events are to occur within the present time step. If there are, then they are processed; if not, time advances by another DT. If no more events are listed, the game is over.

At game's end, the next case is considered. Should there be none, AIRWAR exits.

3.3 MODEL LIMITATIONS

AIRWAR II has certain limitations which we should specifically mention:

The resupply of SAMs, aircraft, and sortie generating supplies (here called reinforcements) in no way represents an optimal allocation scheme.

Launch vehicles automatically receive more SAMs at reinforcement time, whether they need them or not. Aircraft and supplies arrive at bases dependent only upon runway damage and immediate potential to generate sorties. No attempt is made to look ahead in time to optimize allocation.

During the air-to-air portion of the battle, aircraft are initially proportioned into separate groups dependent upon the respective numbers of each type of aircraft. These groups then fight their own battles independently. There is no dynamic reapportioning between salvos.

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4 RUN PREPARATION

4.1 RUN ENVIRONMENT

This program has been written in FORTRAN 77 (ANSI X3.9-1978) for the GRC VAX 11/780, VMS Version 3.0. It has been transferred to a CDC CYBER, NOS Version 2.1 with Tektronix graphic terminal at Wright Patterson AFB.

AIRWAR and the post-processor plot routine AIRPLT require a FTN5 compiler and the standard CDC mathematical library. AIRPLT also uses TCS (Terminal Control System) and AG2 (Advanced Graphics II) resident in PLOT10, a CDC version of Tektronix graphic support.

The user may choose to review plots interactively on the graphics terminal, or request hardcopy of standard plots.

Fortran source resides in the NOS direct access permanent files AIRWAR and AIRPLT. Procedure files AWCOM and APCOM make the necessary file assignments to run the respective programs.

4.2 INPUT FILE

The input file contains twelve mandatory namelists and four optional "event" namelists. Each mandatory namelist begins with a name ending in "IN" (identified in parentheses below). Within each namelist, variables are listed alphabetically and defined in this section. As an aid to the user, the majority of the text below is also contained at the beginning of subroutine READIT.

For every run, there are distances relative to the FEBA which determine the proximity of bases and defensive zones for each force. The distances are illustrated in Fig. 4.1. Note that both Red and Blue have defensive zones, bases, etc., although the numerical values and the number of systems or zones will most likely differ.

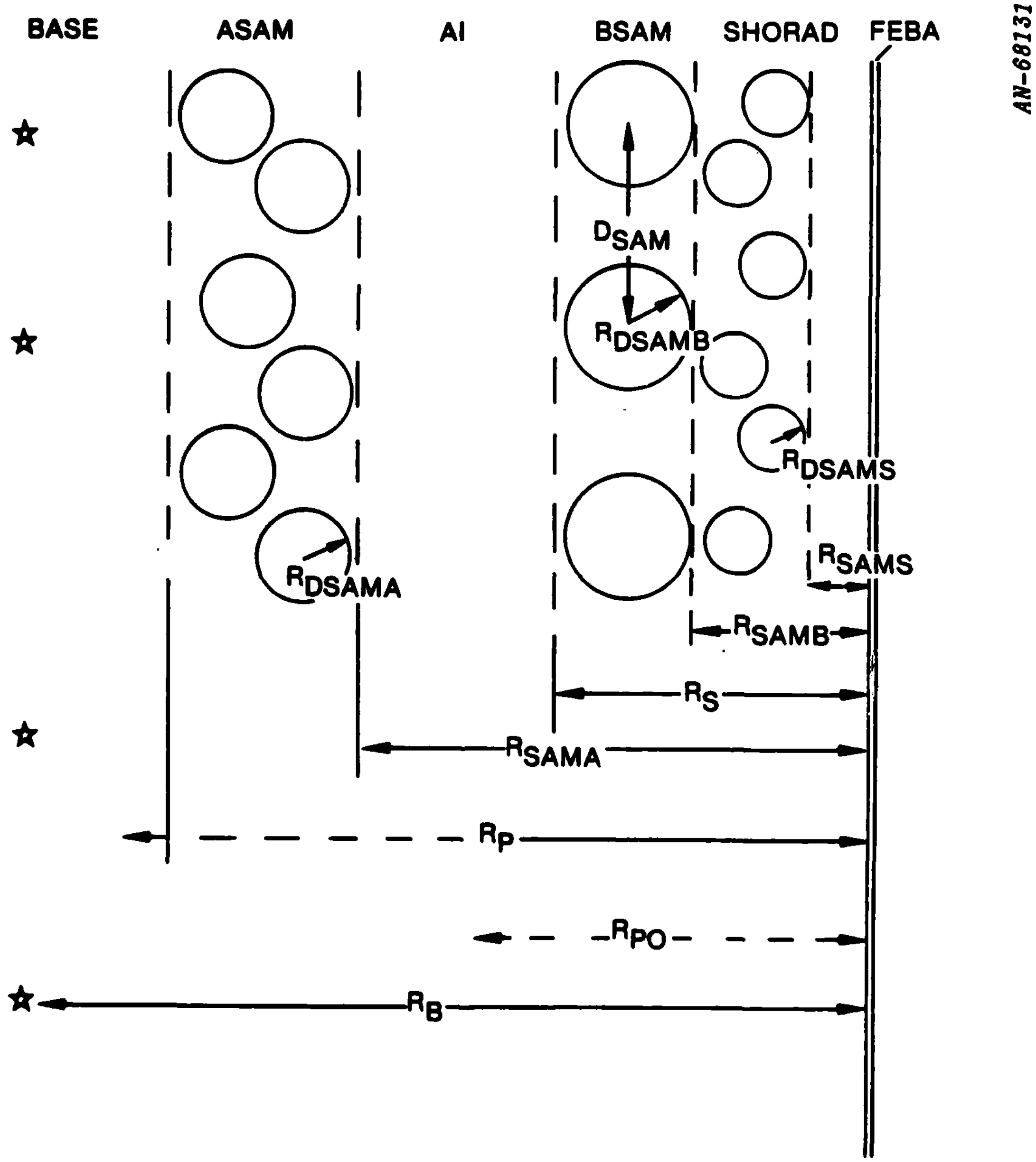


Figure 4.1. AIRWARII Relative Proximities and Zones

Namelist data is input from a data file in the form shown in the sample (Sec. 4.2.7). The order of data within each namelist, and the order of namelists, are not significant except as noted. Each namelist begins and ends with a dollar sign. Named items within a namelist are separated by commas. Arrays may be input in either of two forms: X(1,1)=1.,2.,3.,4.,5.,6., is equivalent to X(1,1)=1., X(2,1)=2., X(3,1)=3.,X(1,2)=4., X(2,2)=5., X(3,2)=6. Note the order in which the subscripts are varied. It is also possible to initialize an array in the form X(1,1)=36*1., (set all 36 values to 1.),followed by settings for particular array elements, e.g., X(3,2)=.1.

****

If a particular variable is not needed, it should be omitted from the namelist, not entered as zero. This will guarantee that default values are used, avoiding program failure due to "divide by zero," etc.

****

4.2.1 <u>Run Inputs</u>

This namelist consists of one input, NCASES. This input allows a number of cases to be run with one input file, thereby eliminating duplication of files, namelists with all variables, etc. when the user wishes to vary the case parameters. Maximums, such as the maximum number of aircraft types, are determined by array dimension within the program.

(RUNIN) NCASES = NUMBER OF CASES TO BE RUN WITH THE CURRENT INPUT FILE

4.2.2 <u>Case Inputs</u>

Case inputs define the parameters that can be varied for each case run. (The namelist is required even if NCASES=1.)

(CASEIN)

DT = CYCLE TIME, HR

KCASE = CASE NUMBER

KCALC = CALCULATION OPTION FLAG FOR JAMMERS

0 = USE ECM DEGRADE FACTORS

1 = COMPUTE DELAY TIMES TO BURN THROUGH AND TO EVALUATE STROBES

2 = COMPUTE DELAY TIMES PLUS SIGNAL DILUTION

KPRNT = PRINT FLAG

-1 = OUTPUT ONLY AT LAUNCH AFTER SPECIFIED TIME

0 = OUTPUT AT LAUNCH EVENTS; ATTRITION AND BOMBS DROPPED VS DEFENSIVE ZONES; GRAPHICS

1 = 0 + OUTPUT AT EVERY EVENT

4 = 1 + DEBUG OUTPUT

TPRNT = SPECIFIED TIME AFTER WHICH OUTPUT IS PRODUCED (KPRNT=-1), HR.

4.2.3 Red Inputs--Exclusive

These inputs are used for Red aircraft only. They define Red's position vs Blue's. Subscript I enumerates Red aircraft types (maximum 6); subscript K enumerates Red salvo types (maximum 3). Subscripts J and L do the same for Blue. The symbol P is used as an abbreviation of "probability."

(REDIN)

MSR(I,K) = MISSILES PER SALVO, ITH RED'S KTH MISSILE TYPE

PDRB(I,J) = P ITH RED DETECTS/CONVERTS ON JTH BLUE

PDRR(I,IPRIME) = P ITH RED DETECTS/CONVERTS ON IPRIMETH RED

PIDRB(I,J) = P ITH RED MISTAKES JTH BLUE FOR RED & DOESN'T SHOOT

PFR(I,IPRIME) = P ITH RED SHOOTS IPRIMETH RED

PKSSR(I,K) = P OF KILL, SINGLE SHOT, ITH RED'S KTH MISSILE TYPE

PROB(I,J,K,L) = P ITH RED'S KTH SALVO OUTSHOOTS JTH BLUE'S LTH (OUTSHOOT DEFINED AS: I KILLS J BEFORE J's MISSILE GOES AUTONOMOUS)

PROR(I,IPRIME,K,KPRIME) = P ITH RED'S KTH SALVO OUTSHOOTS IPRIMETH RED'S KPRIMETH SALVO

4.2.4 Blue Inputs--Exclusive

These inputs are used for Blue aircraft only. They define Blue's position vs Red's.

(BLUEIN)
MSB(J,L) = MISSILES PER SALVO, JTH BLUE'S LTH MISSILE TYPE
PDBR(J,I) = P JTH BLUE DETECTS/CONVERTS ON ITH RED
PDBB(J,JPRIME) = P JTH BLUE DETECTS/CONVERTS ON JPRIMETH BLUE
PIDBR(J,I) = P JTH BLUE MISTAKES ITH RED FOR BLUE & DOESN'T SHOOT
PFB(J,JPRIME) = P JTH BLUE SHOOTS JPRIMETH BLUE
PKSSB(J,L) = P OF KILL, SINGLE SHOT, JTH BLUE'S LTH MISSILE TYPE
PBOR(J,I,L,K) = P JTH BLUE'S LTH SALVO OUTSHOOTS ITH RED'S KTH
PBOB(J,JPRIME,L,LPRIME) = P JTH BLUE'S LTH SALVO OUTSHOOTS JPRIMETH BLUE'S LPRIMETH SALVO

Note that one of the Blue arrays must be complementary to the corresponding Red array in the following way: $PBOR(J,I,L,K) \leq 1-PROB(I,J,K,L)$. A similar complementarity must be observed if non-zero values are entered in arrays PBOB, PROR.

4.2.5 Common Inputs

Common inputs are common only in that they share the same array name regardless of their affiliation with Red or Blue forces. Affiliation is indicated by the array subscript ID. These inputs are all those not specifically detailing the air-to-air combat.

4.2.5.1 All Aircraft

These inputs include aircraft operating parameters, distribution, etc. Subscript ID indicates Red (1) or Blue (2). Subscript IJ enumerates aircraft types. If inputting escorts as a function of the number of ground attack flying, types 1 and 2 must be ground attack aircraft and types 3, 4, or 5 escorts. Type 6 is considered a "Wild Weasel" SAM suppression aircraft.

However, all aircraft may carry air-to-surface and/or air-to-air missiles and may fly both offensive and defensive missions. Subscript IPS indicates primary (1) or secondary (2) airbases.

(ALLACIN)

ACRFT(IJ,ID) = INITIAL NUMBER OF A/C

FA(IJ,ID) = FRACTION A/C TO SECONDARY BASES INITIALLY

FDR(ID) = FRACTIONAL DESTRUCTION OF PRIMARY RUNWAYS AT WHICH A/C ARE DIVERTED TO SECONDARY AIRFIELDS

FDSB(ID) = FRACTIONAL DESTRUCTION OF PRIMARY AT WHICH ID-TH SECONDARY GETS BOMBED

FRUN(ID) = FRACTION OF GROUND ATTACK A/C WEAPONS TO RUNWAY ATTACK

(FRUN(ID) + FSLTR(ID) $\leq$ 1)

FSLTR(ID) = FRACTION OF GROUND ATTACK A/C WEAPONS TO SHELTER ATTACK

FW(M,IJ,ID) = FRACTION OF WEAPONS DELIVERED OVER M-TH SEGMENT BY IJ,ID-TH A/C

FWDPS(ID) = FRACTION OF WEAPONS DELIVERED TO SECONDARY AIRFIELDS BY ID-TH ATTACKER

KTYPE(ID) = FLAG FOR AI USAGE (0=CAP OPERATION,1=SURGE)

NAW(IJ,ID) = NUMBER GROUND ATTACK WEAPONS CARRIED BY IJ,ID-TH A/C

PKR(ID) = P BOMBS KILLING RUNWAY TAKEOFF LENGTH

PKSLTR(ID) = P SHELTER KILL BY G-A A/C

RM(IJ,ID) = MAX COMBAT RADIUS OF IJ,ID-TH A/C, NM

RB(IJ,ID) = BASE DISTANCE FROM FEBA OF IJ,ID-TH A/C, NM

RPO(IJ,ID) = FIRST GROUND ATTACK WEAPON RELEASE OF IJ,ID-TH A/C AFTER CROSSING FEBA, NM

RP(IJ,ID) = MAX. PENETRATION DISTANCE BEYOND FEBA OF IJ,ID-TH A/C, NM

RS(IJ,ID) = STANDOFF RANGE FROM FEBA FOR THE IJ,ID-TH A/C, NM

SUPLY(IJ,ID,IPS) = NUMBER OF SORTIES WHICH CAN BE GENERATED BY SUPPLIES (FUEL, WEAPONS, ETC.) ON HAND

TAT(IJ,ID,IPS) = TURN AROUND TIME OF IJ,ID-TH A/C, HR

TENG(IJ,ID) = AVERAGE TIME OF ENGAGEMENT FOR IJ,ID-TH A/C, HR

TLR(IJ,ID) = LOITER TIME/RANGE SLOPE OF IJ,ID-TH A/C

V(IJ,ID) = AVERAGE SPEED OF IJ,ID-TH A/C, NM/HR

XSAT(ID) = MAXIMUM NUMBER OF A/C AWACS CAN TRACK

NOTE: By setting appropriate values for RPO, RP, and FW, and by letting FRUN and FSLTR equal zero (no bombs dropped on runways or shelters), one can assume that the bombs delivered in each zone were delivered against targets within that zone.

4.2.5.2 SAMs

This namelist defines the SAM capabilities, numbers, supplies, and distribution. The subscript L enumerates SAM types (maximum 3 for each kind--SHORAD, barrier, area). The subscript K refers to those three kinds--SHORAD, barrier, area in that order.

(SAMIN)

ADENSI(L,ID) = AREA DENSITY OF TERMINAL SAMS, INITIAL, #/NM2

DSAMI(L,ID) = DISTANCE BETWEEN BARRIER SAMS, INITIAL, NM

NSAMA(L,ID) = # OF SAM LAUNCHERS PER AREA LAUNCH VEHICLE

NSAMB(L,ID) = # OF SAM LAUNCHERS PER BARRIER LAUNCH VEHICLE

NSAMS(L,ID) = # OF SAM LAUNCHERS PER SHORAD LAUNCH VEHICLE

NSAMLA(L,ID) = # OF LAUNCH VEHICLES PER AREA SAM SITE

NSAMLB(L,ID) = # OF LAUNCHERS PER BARRIER SAM SITE

NSAMLS(L,ID) = # OF LAUNCHERS PER SHORAD SITE

NSLSAS(L,ID) = # OF SHOOT-LOOK-SHOOTS PER AREA SAM LAUNCHER

NSLSBS(L,ID) = # OF SHOOT-LOOK-SHOOTS PER BARRIER SAM LAUNCHER

NSLSS(L,ID) = # OF SHOOT-LOOK-SHOOTS PER SHORAD LAUNCHER

PKSA(L,IJ,ID) = P OF KILL, SINGLE SHOT OF L,ID-TH AREA SAM

PKSB(L,IJ,ID) = P OF KILL, SINGLE SHOT OF L,ID-TH BARRIER SAM

PKSS(L,IJ,ID) = P OF KILL, SINGLE SHOT OF L,ID-TH SHORAD

RDSAMA(L,ID) = SAM RADIUS OF DESTRUCTION, AREA, NM

RDSAMB(L,ID) = SAM RADIUS OF DESTRUCTION, BARRIER, NM
RDSAMS(L,ID) = RADIUS OF DESTRUCTION, SHORAD, NM
RSAMA(L,ID) = SAM STANDOFF RANGE, AREA, NM
RSAMB(L,ID) = SAM STANDOFF RANGE, BARRIER, NM
RSAMS(L,ID) = STANDOFF RANGE, SHORAD, NM
SDENSI(L,ID) = SHORAD DENSITY, INITIAL, #/SQ.NM
SAMNR(L,K,ID) = INITIAL # SAMS AVAILABLE PER LAUNCH VEHICLE

4.2.5.3 SAM/Weasel

The parameters involved in determining the SAM/Weasel battle are input through the following variable names.

(SAMWIN)
NASMI(L,IO) = # OF TYPE-L,ID AREA SAM SITES, INITIAL
NBRRI(1,ID) = # of TYPE-L,ID BARRIER SAM SITES, INITIAL
NSHDI(,ID) = # OF TYPE-L,ID SHORAD SITES, INITIAL
NHARMA(L,ID)= # OF MISSILES TARGETED TO THE LTH AREA SAM BY AN IDTH WEASEL
NHARMB(L,ID)= # OF MISSILES TARGETED TO THE LTH BARRIER SAM BY AN IDTH WEASEL
NHARMS(L,ID)= # OF MISSILES TARGETED TO THE LTH SHORAD BY AN IDTH WEASEL
PKAW(L,ID) = P AREA SAM OF TYPE-L,ID KILLS WEASEL
PKBW(L,ID) = P BARRIER SAM OF TYPE-L,ID KILLS WEASEL
PKSW(L,ID) = P SHORAD OF TYPE-L,ID KILLS WEASEL
PKWA(L,ID) = P WEASEL KILLS AREA SAM OF TYPE-L,ID
PKWB(L,ID) = P WEASEL KILLS BARRIER SAM OF TYPE-L,ID
PKWS(L,ID) = P WEASAL KILLS SHORAD OF TYPE-L,ID

4.2.5.4 AWACS/ECM

These inputs drive the submodel for AWACS and ECM use.

(AWECMIN)
AECMS(ID) = ADJ. FACTOR ON DETECTION/CONVERSIONS FOR ECM ON AWACS
AECMA(IJ,ID) = ADJ. FACTOR ON DETECTION/CONVERSIONS FOR ECM ON IJ-TH A/C TYPE

DR(ID) = AWACS DET. RANGE, NM

RBS(ID) = AWACS BURNTHROUGH RANGE, NM

RBA(ID) = AI DET. RANGE (AI DETECTS ANOTHER A/C), NM

TS(ID) = TIME DELAY FOR STROBE ACQ., HR

4.2.5.5 Ground Operations

Parameters included in this group dictate the ground operations concerning aircraft at airbases.

(GROPIN)

AMANLT(IJ,ID) = TOTAL NUMBER PLANES WHICH CAN BE IN MAINTENANCF FOR IJ,ID-TH A/C, PLANES

CBNF(ID) = CHEMICAL, BIOLOGIGAL, NUCLEAR FRACTIONAL INCREASE IN REPAIR AND TURNAROUND TIMES AT ID-TH AIRBASES

DAMLOS(IJ,ID) = DAMAGE TO LOSS RATIO FOR IJ,ID-TH A/C

DMTTR(IJ,ID) = MEAN TIME TO REPAIR DAMAGED A/C OF IJ,ID-TH TYPE, HR

FMTTR(IJ,ID) = MEAN TIME TO REPAIR FAILED A/C OF IJ,ID-TH TYPE, HR

FOP(ID) = FRACTIONAL OPERABILITY OF SECONDARY AIRFIELD RELATIVE TO PRIMARY

PDBRP(IJ,ID) = P IJ,ID-TH A/C DAMAGED BEYOND REPAIR

PRDY(IJ,ID) = FRACTION OF IJ,ID-TH A/C READY AT START

RHO(IJ,ID) = RELATIVE FRACTION OF DEFENDER-TO-ATTACKER A/C WANTED

TOL(IJ,ID) = TAKEOFF DISTANCE FOR IJ,ID-TH BLUE A/C, FT

TRNLMT(IJ,ID) = MAX NUMBER OF IJ,ID-TH A/C IN TURNAROUND

XMTBF(IJ,ID) = MEAN TIME BETWEEN FAILURES OF IJ,ID-TH A/C, HR

4.2.5.6 Ground Operations--Rea. Estate

Physical properties of ground operations are here defined.

(GROPRIN)

IOPTR(ID) = REPAIR OPTION

- -1 = ADD BROKEN A/C TO MAINTENANCE FIRST, THEN DAMAGED, BUT DON'T TAKE OUT DAMAGED TO MAKE ROOM FOR BROKEN.
- 1 = ADD BROKEN A/C TO MAINTENANCE FIRST, THEN DAMAGED, BUT DON'T TAKE OUT DAMAGED TO MAKE ROOM FOR BROKEN. ALSO, DAMAGED A/C DO NOT BREAK DOWN DURING REPAIR.
- 2 = ADD FIRST BROKEN, THEN DAMAGED, TO MAINTENANCE; DO NOT REMOVE DAMAGED TO MAKE ROOM.
- 3 = REMOVE DAMAGED TO MAKE ROOM FOR BROKEN.

XRUN(ID,IPS) = NUMBER OF RUNWAYS
XLRUN(ID,IPS) = MEAN RUNWAY LENGTH, FT
TFIX(ID) = MEAN TIME TO REPAIR RUNWAYS, HR

NOTE: IOPTR is further explained in Sec. 5.3.

4.2.6 Events

The number of events of each kind must be defined before the events may be input. An EVENT namelist is input for each event.

(PSIN)
NAC = # OF ATTACK EVENTS
NRAC = # OF AIRCRAFT REINFORCEMENT EVENTS
NSAC = # OF SAM REINFORCEMENT EVENTS
NSUP = # OF SUPPLY REINFORCEMENT EVENTS

4.2.6.1 Launch Attacks

(EVENT1)

AC(1) = ATTACK EVENT NUMBER, 1.

AC(2) = ATTACK TIME, HR

AC(3) = WHO ATTACKS (+1 = RED, -1 = BLUE)

AC(4) = DESIRED RAID SIZE OF TYPE-1 A/C

AC(5) = MIN RAID SIZE OF TYPE-1 A/C

AC(6) TO AC(15) DESIRED AND MIN RAID SIZES FOR TYPE-2,...,TYPE-6 A/C

NOTES. Numbers of ground attackers, AC(4) to AC(7), must be input as number of aircraft. Numbers of other aircraft, AC(8) to AC(15), may optionally be input as a multiplier to be applied to the calculated actual number of ground attack aircraft. A negative input signals this option. Example: AC(14) = -.1 would indicate a desired number of Wild Weasels equal to one-tenth the number of ground attackers.

4.2.6.2 Aircraft Reinforcement

(EVENT4)

RAC(1) = REINFORCEMENT EVENT NUMBER, 4.

RAC(2) = REINFORCEMENT TIME, HR

RAC(3) = WHO REINFORCES (+1 = RED, -1 = BLUE)

RAC(4) = REINFORCEMENT SIZE FOR A/C TYPE 1

RAC(5) TO RAC(9) REINFORCEMENT SIZE FOR A/C TYPES 2-6

NOTE: RAC(4)-RAC(9) can only be input as number of aircraft.

4.2.6.3 Aircraft Sortie Supplies Reinforcement

(EVENT6)

SPRS(1) = REINFORCEMENT EVENT NUMBER, 6.

SPRS(2) = REINFORCEMENT TIME, HR

SPRS(3) = WHO REINFORCES (+1 = RED, -1 = BLUE)

SPRS(4) = QUANTITY OF SUPPLIES (NUMBER OF SORTIES POSSIBLE) FOR A/C TYPE 1

SPRS(5) TO SPRS(9) QUANTITY OF SUPPLIES FOR A/C TYPES 2-6

4.2.6.4 SAM Reinforcement

(EVENT5)

SMRS(1) = REINFORCEMENT EVENT NUMBER, 5.

SMRS(2) = REINFORCEMENT TIME, HR

SMRS(3) = WHO REINFORCES (+1 = RED, -1 = BLUE)

SMRS(4) TO SMRS(6) NO. OF SAMS TO 3 TYPES OF LAUNCH VEHICLES IN SHORAD AREA

SMRS(7) TO SMRS(9) AS ABOVE IN BSAM AREA

SMRS(10) TO SMRS(12) AS ABOVE IN ASAM AREA

4.2.7 Example Input File

Following is a sample input file. There is only one case (NCASES=1) to be run. Output is desired at all events (KPRNT=1, TPRNT=0). There are 3 Red and 3 Blue attacks with a summary at 24 hours (the summary is invoked by a dummy attack, thus NAC = 6 attacks + 1 summary = 7). Blue receives aircraft, SAM, and supply reinforcements. Both Red and Blue have primary and secondary airbases.

```
$RUNIN NCASES=1 $

$CASEIN
 DT=0.1 , KCASE=1 , KCALC=1 , KPRNT=1, TPRNT=0. $

$REDIN

 PROB(3,1,1,1)=1. , PROB(3,1,1,2)=1. , PROB(3,1,1,3)=1. ,
 PROB(3,1,2,2)=1. , PROB(3,1,2,3)=1. , PROB(3,1,3,3)=1. ,
 PROB(3,1,3,1)=1. , PROB(3,1,3,2)=1. , PROB(3,1,2,1)=1. ,

 PROB(3,2,1,1)=1. , PROB(3,2,1,2)=1. , PROB(3,2,1,3)=1. ,
 PROB(3,2,2,2)=1. , PROB(3,2,2,3)=1. , PROB(3,2,3,3)=1. ,
 PROB(3,2,3,1)=1. , PROB(3,2,3,2)=1. , PROB(3,2,2,1)=1. ,

 PROB(3,3,1,1)=.57 , PROB(3,3,2,2)=.57 , PROB(3,3,3,3)=.57 ,
 PROB(3,3,1,2)=1. , PROB(3,3,1,3)=1. , PROB(3,3,2,3)=1. ,

 PROB(3,4,1,1)=.43 , PROB(3,4,2,2)=.43 , PROB(3,4,3,3)=.43 ,
 PROB(3,4,1,2)=1. , PROB(3,4,1,3)=1. , PROB(3,4,2,3)=1. ,

 PROB(3,5,1,1)=.75 , PROB(3,5,2,2)=.75 , PROB(3,5,3,3)=.75 ,
 PROB(3,5,1,2)=1. , PROB(3,5,1,3)=1. , PROB(3,5,2,3)=1. ,

 PROB(4,1,1,1)=1. , PROB(4,1,1,2)=1. , PROB(4,1,1,3)=1. ,
 PROB(4,1,2,2)=1. , PROB(4,1,2,3)=1. , PROB(4,1,3,3)=1. ,
 PROB(4,1,3,1)=1. , PROB(4,1,3,2)=1. , PROB(4,1,2,1)=1. ,

 PROB(4,2,1,1)=1. , PROB(4,2,1,2)=1. , PROB(4,2,1,3)=1. ,
 PROB(4,2,2,2)=1. , PROB(4,2,2,3)=1. , PROB(4,2,3,3)=1. ,
 PROB(4,2,3,1)=1. , PROB(4,2,3,2)=1. , PROB(4,2,2,1)=1. ,

 PROB(4,3,1,1)=.67 , PROB(4,3,2,2)=.67 , PROB(4,3,3,3)=.67 ,
 PROB(4,3,1,2)=1. , PROB(4,3,1,3)=1. , PROB(4,3,2,3)=1. ,
```

Figure 4.2. Sample Input File

```
PROB(4,4,1,1)=.50 , PROB(4,4,2,2)=.50 , PROB(4,4,3,3)=.50 ,
PROB(4,4,1,2)=1. , PROB(4,4,1,3)=1. , PROB(4,4,2,3)=1. ,

PROB(4,5,1,1)=.75 , PROB(4,5,2,2)=.75 , PROB(4,5,3,3)=.75 ,
PROB(4,5,1,2)=1. , PROB(4,5,1,3)=1. , PROB(4,5,2,3)=1. ,

PROB(5,1,1,1)=1. , PROB(5,1,1,2)=1. , PROB(5,1,1,3)=1. ,
PROB(5,1,2,2)=1. , PROB(5,1,2,3)=1. , PROB(5,1,3,3)=1. ,
PROB(5,1,3,1)=1. , PROB(5,1,3,2)=1. , PROB(5,1,2,1)=1. ,

PROB(5,2,1,1)=1. , PROB(5,2,1,2)=1. , PROB(5,2,1,3)=1. ,
PROB(5,2,2,2)=1. , PROB(5,2,2,3)=1. , PROB(5,2,3,3)=1. ,
PROB(5,2,3,1)=1. , PROB(5,2,3,2)=1. , PROB(5,2,2,1)=1. ,

PROB(5,3,1,1)=.25 , PROB(5,3,2,2)=.25 , PROB(5,3,3,3)=.25 ,
PROB(5,3,1,2)=1. , PROB(5,3,1,3)=1. , PROB(5,3,2,3)=1. ,

PROB(5,4,1,1)=.25 , PROB(5,4,2,2)=.25 , PROB(5,4,3,3)=.25 ,
PROB(5,4,1,2)=1. , PROB(5,4,1,3)=1. , PROB(5,4,2,3)=1. ,

PROB(5,5,1,1)=.50 , PROB(5,5,2,2)=.50 , PROB(5,5,3,3)=.50 ,
PROB(5,5,1,2)=1. , PROB(5,5,1,3)=1. , PROB(5,5,2,3)=1. ,

PDRB(3,1)=.70 , PDRB(3,2)=.70 , PDRB(3,3)=.53 ,
PDRB(3,4)=.53 , PDRB(3,5)=.53 , PDRB(3,6)=.0 ,

PDRB(4,1)=.80 , PDRB(4,2)=.80 , PDRB(4,3)=.63 ,
PDRB(4,4)=.63 , PDRB(4,5)=.63 , PDRB(4,6)=.0 ,

PDRB(5,1)=.40 , PDRB(5,2)=.40 , PDRB(5,3)=.31 ,
PDRB(5,4)=.31 , PDRB(5,5)=.31 , PDRB(5,6)=.0 ,

MSR(1,1)=2*0,3*2,3*0,3*2,3*0,3*2,0 ,
```

Figure 4.2. (Cont.)

```
PKSSR(1,1)=2*0.,.23,.25,.12,3*0.,.23,.25,.12,3*0.,.23,.25,.12,0. ,
PIDRB(1,1)=36*1.0 $

$BLUEIN

PBOR(3,1,1,1)=1. , PBOR(3,1,1,2)=1. , PBOR(3,1,1,3)=1. ,
PBOR(3,1,2,2)=1. , PBOR(3,1,2,3)=1. , PBOR(3,1,3,3)=1. ,
PBOR(3,1,3,1)=1. , PBOR(3,1,3,2)=1. , PBOR(3,1,2,1)=1. ,

PBOR(3,2,1,1)=1. , PBOR(3,2,1,2)=1. , PBOR(3,2,1,3)=1. ,
PBOR(3,2,2,2)=1. , PBOR(3,2,2,3)=1. , PBOR(3,2,3,3)=1. ,
PBOR(3,2,3,1)=1. , PBOR(3,2,3,2)=1. , PBOR(3,2,2,1)=1. ,

PBOR(3,3,1,1)=.43 , PBOR(3,3,2,2)=.43 , PBOR(3,3,3,3)=.43 ,
PBOR(3,3,1,2)=1. , PBOR(3,3,1,3)=1. , PBOR(3,3,2,3)=1. ,

PBOR(3,4,1,1)=.33 , PBOR(3,4,2,2)=.33 , PBOR(3,4,3,3)=.33 ,
PBOR(3,4,1,2)=1. , PBOR(3,4,1,3)=1. , PBOR(3,4,2,3)=1. ,

PBOR(3,5,1,1)=.75 , PBOR(3,5,2,2)=.75 , PBOR(3,5,3,3)=.75 ,
PBOR(3,5,1,2)=1. , PBOR(3,5,1,3)=1. , PBOR(3,5,2,3)=1. ,

PBOR(4,1,1,1)=1. , PBOR(4,1,1,2)=1. , PBOR(4,1,1,3)=1. ,
PBOR(4,1,2,2)=1. , PBOR(4,1,2,3)=1. , PBOR(4,1,3,3)=1. ,
PBOR(4,1,3,1)=1. , PBOR(4,1,3,2)=1. , PBOR(4,1,2,1)=1. ,
PBOR(4,2,3,1)=1. , PBOR(4,2,3,2)=1. , PBOR(4,2,2,1)=1. ,

PBOR(4,2,1,1)=1. , PBOR(4,2,1,2)=1. , PBOR(4,2,1,3)=1. ,
PBOR(4,2,2,2)=1. , PBOR(4,2,2,3)=1. , PBOR(4,2,3,3)=1. ,
PBOR(4,2,3,1)=1. , PBOR(4,2,3,2)=1. , PBOR(4,2,2,1)=1. ,

PBOR(4,3,1,1)=.57 , PBOR(4,3,2,2)=.57 , PBOR(4,3,3,3)=.57 ,
PBOR(4,3,1,2)=1. , PBOR(4,3,1,3)=1. , PBOR(4,3,2,3)=1. ,
```

Figure 4.2. (Cont.)

```
PBOR(4,4,1,1)=.50 , PBOR(4,4,2,2)=.50 , PBOR(4,4,3,3)=.50 ,
PBOR(4,4,1,2)=1. , PBOR(4,4,1,3)=1. , PBOR(4,4,2,3)=1. ,

PBOR(4,5,1,1)=.75 , PBOR(4,5,2,2)=.75 , PBOR(4,5,3,3)=.75 ,
PBOR(4,5,1,2)=1. , PBOR(4,5,1,3)=1. , PBOR(4,5,2,3)=1. ,

PBOR(5,1,1,1)=1. , PBOR(5,1,1,2)=1. , PBOR(5,1,1,3)=1. ,
PBOR(5,1,2,2)=1. , PBOR(5,1,2,3)=1. , PBOR(5,1,3,3)=1. ,
PBOR(5,1,3,1)=1. , PBOR(5,1,3,2)=1. , PBOR(5,1,2,1)=1. ,

PBOR(5,2,1,1)=1. , PBOR(5,2,1,2)=1. , PBOR(5,2,1,3)=1. ,
PBOR(5,2,2,2)=1. , PBOR(5,2,2,3)=1. , PBOR(5,2,3,3)=1. ,
PBOR(5,2,3,1)=1. , PBOR(5,2,3,2)=1. , PBOR(5,2,2,1)=1. ,

PBOR(5,3,1,1)=.25 , PBOR(5,3,2,2)=.25 , PBOR(5,3,3,3)=.25 ,
PBOR(5,3,1,2)=1. , PBOR(5,3,1,3)=1. , PBOR(5,3,2,3)=1. ,

PBOR(5,4,1,1)=.25 , PBOR(5,4,2,2)=.25 , PBOR(5,4,3,3)=.25 ,
PBOR(5,4,1,2)=1. , PBOR(5,4,1,3)=1. , PBOR(5,4,2,3)=1. ,

PBOR(5,5,1,1)=.50 , PBOR(5,5,2,2)=.50 , PBOR(5,5,3,3)=.50 ,
PBOR(5,5,1,2)=1. , PBOR(5,5,1,3)=1. , PBOR(5,5,2,3)=1. ,

PDBR(3,1)=.70 , PDBR(3,2)=.70 , PDBR(3,3)=.49 ,
PDBR(3,4)=.49 , PDBR(3,5)=.49 , PDBR(3,6)=.0 ,

PDBR(4,1)=.80 , PDBR(4,2)=.80 , PDBR(4,3)=.63 ,
PDBR(4,4)=.63 , PDBR(4,5)=.63 , PDBR(4,6)=.0 ,

PDBR(5,1)=.40 , PDBR(5,2)=.40 , PDBR(5,3)=.31 ,
PDBR(5,4)=.31 , PDBR(5,5)=.31 , PDBR(5,6)=.0 ,

MSB(1,1)=2*0,3*2,3*0,3*2,3*0,3*2,0 ,
PKSSB(1,1)=2*0.,.22,.22,.11,3*0.,.22,.22,.11,3*0.,.22,.22,.11,0. ,
```

Figure 4.2. (Cont.)

```
PIDBR(1,1)=36*1.0 $

$SAMIN
 ADENSI(1,1)=3*3.E-03 ,3*4.E-03 ,
 DSAMI(1,1)=3*20. ,3*25. ,
 NSAMA(1,1)=6*2 ,
 NSAMB(1,1)=6*4 ,
 NSAMLA(1,1)=6*2 ,
 NSAMLB(1,1)=6*4 ,
 NSAMLS(1,1)=6*10 ,
 NSAMS(1,1)=6*3 ,
 NSLSAS(1,1)=3*2 ,3*3 ,
 NSLSBS(1,1)=6*2 ,
 NSLSS(1,1)=6*1 ,
 PKSA(1,1,1)=18*0.2 , 18*0.4 ,
 PKSB(1,1,1)=18*.3 , 18*.5 ,
 PKSS(1,1,1)=36*.02 ,
 RDSAMA(1,1)=3*8.,3*12. ,
 RDSAMB(1,1)=3*10. ,3*10. ,
 RDSAMS(1,1)=3*3.,3*4. ,
 RSAMA(1,1)=6*230. ,
 RSAMB(1,1)=6*30. ,
 RSAMS(1,1)=6*5. ,
 SDENSI(1,1)=3*6.E-03,3*3.E-03 ,
 SAMNR(1,1,1)=18*6. $

$SAMWIN
 NASMI(1,1)=3*200 ,3*150 ,
 NBRRI(1,1)=3*100 ,3*75 ,
 NSHDI(1,1)=3*500 ,3*400 ,
 NHARMA(1,1)=6*1 ,
 NHARMB(1,1)=6*1 ,
 NHARMS(1,1)=6*0 ,
 PKAW(1,1)=3*.2 ,3*.4 ,
```

Figure 4.2. (Cont.)

```
PKBW(1,1)=3*.2 ,3*.4 ,
PKSW(1,1)=3*.05 ,3*.05 ,
PKWA(1,1)=3*.05 ,3*.1 ,
PKWB(1,1)=3*.05 ,3*.1 ,
PKWS(1,1)=6*.02 $

$ALLACIN
ACRFTI(1,1)=288.,168.,287.,695.,120.,228.,
            140.,100.,255.,305.,60.,90. ,
FRUN(1)=2*.4 ,
FSLTR(1)=2*.3 ,
FW(1,1,1)=3*0.,2*2.5E-02,.125,.175,.15,2*.25,50*0.,
          3*0.,2*2.5E-02,.125,.175,.15,2*.25 ,
          3*0.,2*2.5E-02,.125,.175,.15,2*.25,40*0. ,
KTYPE(1)=1,1 ,
NAW(1,1)=4,5*0,6,4,4*0 ,
PKR(1)=2*.7 ,
PKSLTR(1)=2*.2 ,
RM(1,1)=12*250. ,
RB(1,1,1)=12*250. ,
RPO(1,1)=12*150. ,
RP(1,1)=12*250. ,
RS(1,1)=6*50., 6*50. ,
TAT(1,1,1)=2*1.5,2*1.2,3*1.5,3*1.1,14*1.5 ,
TENG(1,1)=12*0.092 ,
TLR(1,1)=12*.48 ,
V(1,1)=12*500. ,
XSAT(1)=2*700. ,
SUPLY(1,1,1)=24*3000. $

$AWECMIN
AECMS(1)=2*1. ,
AECMA(1,1)=6*.9, 6*.95 ,
TS(1)=2*.05 ,
```

Figure 4.2. (Cont.)

```
 DR(1)=2*250. ,
 RBS(1)=2*150. ,
 RBA(1,1)=12*75. $

$GROPIN
 AMANLT(1,1)=28.,17.,28.,56.,12.,23.,
            14.,10.,26.,31.,6.,9. ,
 DAMLOS(1,1)=12*1. ,
 DMTTR(1,1)=12*12. ,
 FMTTR(1,1)=12*3. ,
 PDBRP(1,1)=12*.15 ,
 PRDY(1,1)=12*.9 ,
 RHO(1,1)=2*0.,2*.8,4*0.,.25,.58,2*0. ,
 TOL(1,1)=2*4000.,2600.,3000.,3*4000.,2*2600.,3000.,2*4000. ,
 TRNLMT(1,1)=104.,68.,104.,264.,48.,90.,
            56.,40.,102.,122.,24.,36. ,
 XMTBF(1,1)=2*6.,2*7.,2*6.,2*8.,9.,10.,2*8. $

$GROPRIN
 XRUN(1,1)=97.,43.,2*0. ,
 XLRUN(1,1)=2*8000.,2*0. ,
 TFIX(1)=2*24. ,
 IOPTR(1)=2*2 $

$PSIN
 NAC=7, NRAC=1, NSAC=1, NSUP=1 $

$EVENT1 AC(1)=
 1.,0.,1.,106.,0.,64.,0.,45.,0.,105.,0.,43.,0.,62.,0. $
$EVENT1 AC(1)=
 1.,2.5,-1.,140.,0.,100.,0.,150.,0.,60.,0.,20.,0.,30.,0.  $
$EVENT1 AC(1)=
 1.,5.,1.,106.,0.,64.,0.,45.,0.,105.,0.,43.,0.,62.,0. $
$EVENT1 AC(1)=
```

Figure 4.2. (Cont.)

```
 1.,7.5,-1.,140.,0.,100.,0.,150.,0.,60.,0.,20.,0.,30.,0. $
$EVENT1 AC(1)=
 1.,10.,1.,106.,0.,64.,0.,45.,0.,105.,0.,43.,0.,62.,0. $
$EVENT1 AC(1)=
 1.,12.5,-1.,140.,0.,100.,0.,150.,0.,60.,0.,20.,0.,30.,0.  $
$EVENT1 AC(1)=
 1.,24.,1.,12*0. $

$EVENT4 RAC(1)=
 4.,23.,-1.,15.,25.,42.,22.,15.,15. $

$EVENT5 SMRS(1)=
 5.,4.2,-1,9*6. $

$EVENT6 SPRS(1)=
 6.,7.3,-1.,6*500. $
$END
```

Figure 4.2. (Cont.)

4.3 EXECUTION INSTRUCTIONS

This section contains instructions for executiing AIRWARII and its graphics post-processor AIRPLT under the NOS operating system.

4.3.1 AIRWAR

After creating and saving a NOS indirect-access permanent file containing AIRWAR input data, the user must prepare a procedure file like AWCOM.

File AWCOM:

```
.PROC,AW*I,FI"INPUT DATA"=(*F,*N= ),
FO"OUTPUT LISTING"=(*F,*N= ),
FP"PLOT TAPE"=(*F,*N= ).
DEFINE,TAPE7=FP.
DEFINE,TAPE6=FO.
GET,TAPE5=FI.
GET,AIRWAR.
LOAD,AIRWAR.
LDSET,PRESET=ZERO.
EXECUTE.
RETURN,TAPE6.
RETURN,TAPE7.
EXIT.
RETURN,TAPE6.
RETURN,TAPE7.
```

Execution of AIRWAR begins by typing: GET,AWCOM.
BEGIN,AW,AWCOM.

The system will prompt the user to supply file names for input data, output listing, and plot data.

Two output files are produced: TAPE7, which contains data destined for the post-processor AIRPLT, and TAPE6, whose contents may then be listed or edited.

4.3.2 AIRPLT

The post-processor plotting routine AIRPLT requires TAPE7 produced by AIRWAR as input in addition to interactive communication with the user on the Tektronix graphics terminal. The user will prepare a procedure file like APCOM.

File APCOM:

```
.PROC,AP*I,FI"INPUT DATA"=(*F,*N= ).
ATTACH,TAPE7=FI.
ATTACH(TEKLIB/UN=APPLIB)
GET,AIRPLT.
LOAD,AIRPLT.
LDSET(PRESET=ZERO,LIB=TEKLIB)
EXECUTE.
RETURN,TAPE7.
EXIT.
RETURN,TAPE7.
```

Execution may be initiated by typing: GET,APCOM
BEGIN,AP,APCOM

The system will prompt the user to supply the file name of the graphics input generated by AIRWAR.

Soon the screen will begin interrogating the user to determine the desired plots. A variety of plots may be selected and reviewed interactively, with hardcopies produced as desired, or plots may be drawn and hardcopied automatically with no further user interaction. Interrogation from the screen indicates the range of expected responses. The user needs only reply to each one in turn.

5 AIRWARII OUTPUTS

AIRWARII has output options ranging from a four-page summary of start and end conditions to a blow-by-blow account of the complete battle, with graphics and all input variables included.

The following text explains each of the output options, illustrates
them with examples, and defines the various output headings.

5.1 OUTPUT OPTIONS

There are four output options, from the very brief to the very long.
These options give the user, among other things, the ability to see the campaign history in both tabular and graphic form.

For any run, two files are created. One contains the tabular output, which the user may print if desired. The other contains data which can be passed to a graphic post-processor to generate a series of user-selected plots.

The options for tabular output, listed in Sec. 4.2.2, are again listed below, with further clarification.

KPRNT = -1. This option, along with the appropriate value for TPRNT, will list output only at launch events after the time specified in TPRNT. This option is convenient for summarizing a campaign in the following manner: 1. specify in TPRNT a time a few hours after the last attack, then 2., schedule an attack of zero (that's right) aircraft. The end result will be an output totaling four pages that summarizes aircraft killed, sorties, bombs, etc., at both the beginning and end of the battle. Additionally, all input variables and their values are listed.
No graphics available with this option.

KPRNT = 0. More inclusive than the above, yet still relatively brief, this option yields output at every launch event, both attacker and defender. In addition, attacker attrition and bombs dropped as a function of defensive zone are listed. A three-day, six-attacks-per-day war will generate about eighty pages of output. Graphics available.

KPRNT = 1. By specifying KPRNT=1, the user will get all the above, plus output generated at every event. Depending on dispersal to secondary airfields, a three-day, six-attacks-per-day war will generate from 210 to 360 pages of output for each case.

KPRNT = 4. This option gives the user all of the above, plus debug output. It is recommended only for the pprogrammer familiar with AIRWARII code.

5.2 SUMMARY OF INPUT

No matter what value KPRNT may have, the subroutine IOWRTR is always invoked. This subroutine prints the input in a format that is more readable than the standard write of a namelist. IOWRTR lists the input variable names and their values (Fig. 5.1).

The format of this print routine is to list all variable names in the first six lefthand columns of the output. Furthermore, except for the variables from the common blocks REDIN and BLUEIN, numerical values belonging to a specific variable are listed with Red values on the lefthand side of the page and Blue values on the right. Should the variable have multiple values for both Red and Blue, they will be listed on their respective sides of the page in ascending order. Thus, the variable ACRFTI has listed the initial number of aircraft of each type, starting with type 1 and ending with type 6, for Red, followed by six more values for Blue. The variable ADENSI has listed three values corresponding to the three types of Red area SAMs, followed by the three corresponding values for Blue.

Because of the nature of the variables in REDIN and BLUEIN, they are formatted in a different manner. These variables are generally a function of both Blue and Red aircraft types, and so necessitate a correlation with both. To do this, the shooting aircraft type is listed down the lefthand columns, with the shot aircraft listed across the row above these columns. An example is PROB, the probability that Red outshoots Blue, where the Red aircraft type, and the three salvo numbers, are listed down the lefthand columns of the page while the Blue aircraft type, and its three salvos, are listed in the row immediately above the array. The coordinates (1,1) would refer to the probability that Red's first salvo outshoots Blue's first.

PROB 1

RED 1	BLU 1: 1	2	3	BLU 2: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RED 1	BLU 3: 1	2	3	BLU 4: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RED 1	BLU 5: 1	2	3	BLU 6: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PROB 2

RED 2	BLU 1: 1	2	3	BLU 2: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RED 2	BLU 3: 1	2	3	BLU 4: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RED 2	BLU 5: 1	2	3	BLU 6: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PROB 3

RED 3	BLU 1: 1	2	3	BLU 2: 1	2	3
1	1.0	1.0	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0	1.0	1.0

Figure 5.1. Input Summary

RED 3	BLU 1: 1	2	3
1	0.57	1.0	1.0
2	0.00E+00	0.57	1.0
3	0.00E+00	0.00E+00	0.57

RED 3	BLU 4: 1	2	3
1	0.43	1.0	1.0
2	0.00E+00	0.43	1.0
3	0.00E+00	0.00E+00	0.43

RED 3	BLU 5: 1	2	3
1	0.75	1.0	1.0
2	0.00E+00	0.75	1.0
3	0.00E+00	0.00E+00	0.75

RED 3	BLU 6: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PROB

RED 4	BLU 1: 1	2	3
1	1.0	1.0	1.0
2	1.0	1.0	1.0
3	1.0	1.0	1.0

RED 4	BLU 2: 1	2	3
1	1.0	1.0	1.0
2	1.0	1.0	1.0
3	1.0	1.0	1.0

RED 4	BLU 3: 1	2	3
1	0.67	1.0	1.0
2	0.00E+00	0.67	1.0
3	0.00E+00	0.00E+00	0.67

RED 4	BLU 4: 1	2	3
1	0.50	1.0	1.0
2	0.00E+00	0.50	1.0
3	0.00E+00	0.00E+00	0.50

RED 4	BLU 5: 1	2	3
1	0.75	1.0	1.0
2	0.00E+00	0.75	1.0
3	0.00E+00	0.00E+00	0.75

RED 4	BLU 6: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PROB

RED 5	BLU 1: 1	2	3
1	1.0	1.0	1.0
2	1.0	1.0	1.0
3	1.0	1.0	1.0

RED 5	BLU 2: 1	2	3
1	1.0	1.0	1.0
2	1.0	1.0	1.0
3	1.0	1.0	1.0

RED 5	BLU 3: 1	2	3
1	0.25	1.0	1.0
2	0.00E+00	0.25	1.0
3	0.00E+00	0.00E+00	0.25

RED 5	BLU 4: 1	2	3
1	0.25	1.0	1.0
2	0.00E+00	0.25	1.0
3	0.00E+00	0.00E+00	0.25

Figure 5.1. (Cont.)

S L U 5 (RED 5)

	1	2	3
1	0.50	1.0	1.0
2	0.00E+00	0.50	1.0
3	0.00E+00	0.00E+00	0.50

B L U 6

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PROB

S L U 1 (RED 6)

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

B L U 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

S L U 3 (RED 6)

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

B L U 4

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

S L U 5 (RED 6)

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

B L U 6

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PORB

B L U (RED)

	1	2	3	4	5	6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.70	0.70	0.53	0.53	0.53	0.00E+00
4	0.80	0.80	0.63	0.63	0.63	0.00E+00
5	0.40	0.40	0.31	0.31	0.31	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PFR

S L U (RED)

	1	2	3	4	5	6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

5	0.00E+00	0.00E+00	0.00E+10	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PRUR

RED1

RED 1

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 6

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PRUR

RED2

RED 1

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 6

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PRUR

RED

RED 1

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

RED 3 / RED 5	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3 / RED 4	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3 / RED 5	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3 / RED 6	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PROR

RED 4 / RED 1	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4 / RED 2	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4 / RED 3	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4 / RED 4	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4 / RED 5	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 4 / RED 6	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PROR

RED 5 / RED 1	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5 / RED 2	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5 / RED 3	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5 / RED 4	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

		R E D 5			R E D 6	
	1	2	3	1	2	3
R 1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5						

PRUR

		R E D 1			R E D 2	
	1	2	3	1	2	3
R 1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6						

		R E D 3			R E D 4	
	1	2	3	1	2	3
R 1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6						

		R E D 5			R E D 6	
	1	2	3	1	2	3
R 1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6						

PDRR

			R E D			
	1	2	3	4	5	6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
R 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D 4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

MSP

	1	2	3
1	0	0	0
R 2	0	0	0
E 3	2	2	2
D 4	2	2	2
5	2	2	2
6	0	0	0
	1	2	3

Figure 5.1. (Cont.)

PKSSR

RED	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00
	3	0.23	0.23	0.23
	4	0.25	0.25	0.25
	5	0.12	0.12	0.12
	6	0.00E+00	0.00E+00	0.00E+00

PIDRR

		BLU 1	BLU 2	BLU 3	BLU 4	BLU 5	BLU 6
RED	1	1.0	1.0	1.0	1.0	1.0	1.0
	2	1.0	1.0	1.0	1.0	1.0	1.0
	3	1.0	1.0	1.0	1.0	1.0	1.0
	4	1.0	1.0	1.0	1.0	1.0	1.0
	5	1.0	1.0	1.0	1.0	1.0	1.0
	6	1.0	1.0	1.0	1.0	1.0	1.0

PBUR

RED 1

		1	2	3
BLU 1	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00
	3	0.00E+00	0.00E+00	0.00E+00

RED 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3

		1	2	3
BLU 1	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00
	3	0.00E+00	0.00E+00	0.00E+00

RED 4

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 5

		1	2	3
BLU 1	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00
	3	0.00E+00	0.00E+00	0.00E+00

RED 6

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

PBUR

RED 1

		1	2	3
BLU 2	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00
	3	0.00E+00	0.00E+00	0.00E+00

RED 2

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00

RED 3

		1	2	3
BL	1	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	0.00E+00

RED 4

	1	2	3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

```
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
2

            R  E  D    5                            R  E  D    6
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
2

PBOR
            R  E  D    1                            R  E  D    2
        1          2          3               1          2          3
B   1   1.0        1.0        1.0             1.0        1.0        1.0
L   2   1.0        1.0        1.0             1.0        1.0        1.0
U   3   1.0        1.0        1.0             1.0        1.0        1.0
3

            R  E  D    3                            R  E  D    4
        1          2          3               1          2          3
B   1   0.43       1.0        1.0             0.33       1.0        1.0
L   2   0.00E+00   0.43       1.0             0.00E+00   0.33       1.0
U   3   0.00E+00   0.00E+00   0.43            0.00E+00   0.00E+00   0.33
3

            R  E  D    5                            R  E  D    6
        1          2          3               1          2          3
B   1   0.75       1.0        1.0             0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.75       1.0             0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.75            0.00E+00   0.00E+00   0.00E+00
3

PBOR
            R  E  D    1                            R  E  D    2
        1          2          3               1          2          3
B   1   1.0        1.0        1.0             1.0        1.0        1.0
L   2   1.0        1.0        1.0             1.0        1.0        1.0
U   3   1.0        1.0        1.0             1.0        1.0        1.0
4

            R  E  D    3                            R  E  D    4
        1          2          3               1          2          3
B   1   0.57       1.0        1.0             0.50       1.0        1.0
L   2   0.00E+00   0.57       1.0             0.00E+00   0.50       1.0
U   3   0.00E+00   0.00E+00   0.57            0.00E+00   0.00E+00   0.50
4

            R  E  D    5                            R  E  D    6
        1          2          3               1          2          3
B   1   0.75       1.0        1.0             0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.75       1.0             0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.75            0.00E+00   0.00E+00   0.00E+00
```

Figure 5.1. (Cont.)

```
PBUR
                            R E D   1                                      R E D   2
              1             2             3                 1             2             3
B   1      1.0           1.0           1.0               1.0           1.0           1.0
L   2      1.0           1.0           1.0               1.0           1.0           1.0
U   3      1.0           1.0           1.0               1.0           1.0           1.0
S

                            R E D   3                                      R E D   4
              1             2             3                 1             2             3
B   1      0.25          1.0           1.0               0.25          1.0           1.0
L   2      0.00E+00      0.25          1.0               0.00E+00      0.25          1.0
U   3      0.00E+00      0.00E+00      0.25              0.00E+00      0.00E+00      0.25
S

                            R E D   5                                      R E D   6
              1             2             3                 1             2             3
B   1      0.50          1.0           1.0               0.00E+00      0.00E+00      0.00E+00
L   2      0.00E+00      0.50          1.0               0.00E+00      0.00E+00      0.00E+00
U   3      0.00E+00      0.00E+00      0.50              0.00E+00      0.00E+00      0.00E+00
S

PBUR
                            R E D   1                                      R E D   2
              1             2             3                 1             2             3
B   1      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
L   2      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
U   3      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
6

                            R E D   3                                      R E D   4
              1             2             3                 1             2             3
B   1      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
L   2      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
U   3      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
6

                            R E D   5                                      R E D   6
              1             2             3                 1             2             3
B   1      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
L   2      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
U   3      0.00E+00      0.00E+00      0.00E+00          0.00E+00      0.00E+00      0.00E+00
6

                                          R E D
              1          2          3          4          5          6
```

Figure 5.1. (Cont.)

PDSR

B L U	1	2	3	4	5	6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.70	0.70	0.49	0.49	0.49	0.00E+00
4	[illegible]	[illegible]	0.63	0.63	0.63	0.00E+00
5	0.40	0.40	0.31	0.31	0.31	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B L U

PFS

B L U	1	2	3	4	5	6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PBOB

B L U 1	B L U 1: 1	2	3	B L U 2: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B L U 1	B L U 3: 1	2	3	B L U 4: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B L U 1	B L U 5: 1	2	3	B L U 6: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PBOB

B L U 2	B L U 1: 1	2	3	B L U 2: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B	B L U 3: 1	2	3	B L U 4: 1	2	3
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

```
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
2

              B L U      5                          B L U      6
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
2

PBOB
              B L U      1                          B L U      2
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
3

              B L U      3                          B L U      4
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
3

              B L U      5                          B L U      6
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
3

PBOB
              B L U      1                          B L U      2
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
4

              B L U      3                          B L U      4
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+01
U   3   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
4

              B L U      5                          B L U      6
        1          2          3               1          2          3
B   1   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
L   2   0.00E+00   0.00E+00   0.00E+00        0.00E+00   0.00E+00   0.00E+00
```

Figure 5.1. (Cont.)

```
U    5    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
4

PBUB
                   B   L   U      1                                B   L   U      2
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
5

                   B   L   U      3                                B   L   U      4
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
5

                   B   L   U      5                                B   L   U      6
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
5

PBUB
                   B   L   U      1                                B   L   U      2
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
6

                   B   L   U      3                                B   L   U      4
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
6

                   B   L   U      5                                B   L   U      6
             1             2             3             1             2             3
B    1    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
L    2    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
U    3    0.00E+00    0.00E+00    0.00E+00          0.00E+00    0.00E+00    0.00E+00
6
```

B L U

Figure 5.1. (Cont.)

PDSB

		1	2	3	4	5	6
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
L	3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NSB

		1	2	3
	1	0	0	0
B	2	0	0	0
L	3	2	2	2
U	4	2	2	2
	5	2	2	2
	6	0	0	0

PKSSB

		1	2	3
	1	0.00E+00	0.00E+00	0.00E+00
B	2	0.00E+00	0.00E+00	0.00E+00
L	3	0.22	0.22	0.22
U	4	0.22	0.22	0.22
	5	0.11	0.11	0.11
	6	0.00E+00	0.00E+00	0.00E+00

R E D

PIDBR

		1	2	3	4	5	6
	1	1.0	1.0	1.0	1.0	1.0	1.0
B	2	1.0	1.0	1.0	1.0	1.0	1.0
L	3	1.0	1.0	1.0	1.0	1.0	1.0
U	4	1.0	1.0	1.0	1.0	1.0	1.0
	5	1.0	1.0	1.0	1.0	1.0	1.0
	6	1.0	1.0	1.0	1.0	1.0	1.0

******** SAM INFORMATION ********

	RED 1	RED 2	RED 3	BLU 1	BLU 2	BLU 3
ADENSI	0.30E-02	0.30E-02	0.30E-02	0.40E-02	0.40E-02	0.40E-02
OSAMI	20.	20.	20.	25.	25.	25.
NSAM4	2	2	2	2	2	2
NSAM5	4	4	4	4	4	4
NSAMLA	2	2	2	2	2	2

Figure 5.1. (Cont.)

NSAMLB	4	4	4	4	4	4
NSAMLS	10	10	10	10	10	10
NSAMS	3	3	3	3	3	3
NSLSAS	2	2	2	3	3	3
NSLSBS	2	2	2	2	2	2
NSLSS	1	1	1	1	1	1
PKSA						
AC TYP 1	0.20	0.20	0.20	0.40	0.40	0.40
AC TYP 2	0.20	0.20	0.20	0.40	0.40	0.40
AC TYP 3	0.20	0.20	0.20	0.40	0.40	0.40
AC TYP 4	0.20	0.20	0.20	0.40	0.40	0.40
AC TYP 5	0.20	0.20	0.20	0.40	0.40	0.40
AC TYP 6	0.20	0.20	0.20	0.40	0.40	0.40
PKSB						
AC TYP 1	0.30	0.30	0.30	0.50	0.50	0.50
AC TYP 2	0.30	0.30	0.30	0.50	0.50	0.50
AC TYP 3	0.30	0.30	0.30	0.50	0.50	0.50
AC TYP 4	0.30	0.30	0.30	0.50	0.50	0.50
AC TYP 5	0.30	0.30	0.30	0.50	0.50	0.50
AC TYP 6	0.30	0.30	0.30	0.50	0.50	0.50
PKSS						
AC TYP 1	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
AC TYP 2	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
AC TYP 3	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
AC TYP 4	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
AC TYP 5	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
AC TYP 6	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01
RDSAMA	3.0	3.0	9.0	12.	12.	12.
RDSAMB	10.	10.	10.	10.	10.	10.
RDSAMS	3.0	3.0	3.0	4.0	4.0	4.0
RSAMS	0.23E+03	0.23E+03	0.23E+03	0.25E+03	0.25E+03	0.25E+03

Figure 5.1. (Cont.)

RSAMS	30.	30.	30.	30.	30.	30.
RSAMS	5.0	5.0	5.0	5.0	5.0	5.0
SDENSI	0.50E-02	0.50E-02	0.60E-02	0.30E-02	0.30E-02	0.30E-02
SAMNR						
SHORAD	5.0	5.0	5.0	6.0	6.0	6.0
BSAM	5.0	5.0	5.0	6.0	6.0	6.0
ASAM	5.0	5.0	5.0	6.0	6.0	6.0
NASMI	200	200	200	150	150	150
NBRRI	100	100	100	75	75	75
NSHOI	500	500	500	400	400	400
NHARMA	1	1	1	1	1	1
NHARMB	1	1	1	1	1	1
NHARMS	0	0	0	0	0	0
PKAW	0.20	0.20	0.20	0.40	0.40	0.40
PKSW	0.20	0.20	0.20	0.40	0.40	0.40
PKSW	0.50E-01	0.50E-01	0.50E-01	0.50E-01	0.50E-01	0.50E-01
PKWA	0.50E-01	0.50E-01	0.50E-01	0.10	0.10	0.10
PKWB	0.50E-01	0.50E-01	0.50E-01	0.10	0.10	0.10
PKWS	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01	0.20E-01

	RED						BLU					
	1	2	3	4	5	6	1	2	3	4	5	
ACRFTI	0.29E+03	0.17E+03	0.29E+03	0.79E+03	0.12E+03	0.23E+03	0.14E+03	0.10E+03	0.26E+03	0.31E+03	60.	90.
FA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FOP			0.00E+00						0.00E+00			
FDSB			0.00E+00						0.00E+00			
FRUN			0.40						0.40			
FSLTP			0.30						0.30			
FW												
SEGMNT 1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Figure 5.1. (Cont.)

SEGMNT 3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 4	0.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.25E-01	0.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 5	0.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.25E-01	0.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 6	0.13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.13	0.13	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 7	0.17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.17	0.17	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 8	0.15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.15	0.15	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT 9	0.25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.25	0.25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SEGMNT10	0.25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.25	0.25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FMUPS			0.00E+00						0.00E+00			
KTYPS				1						1		
NAW	6	0	0	0	0	0	6	4	0	0	0	0
PKR			0.70						0.70			
PKSLTR			0.20						0.20			
RM	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03
RB												
PRIMARY	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03
SECONDARY	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPU	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03	0.15E+03
RP	0.25E+03	0.25E+03	0.25E+03	0.23E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03	0.25E+03
RS	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
TAT												
PRIMARY	1.5	1.5	1.2	1.2	1.5	1.5	1.5	1.1	1.1	1.1	1.5	1.5
SECONDARY	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
TENG	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01	0.92E-01
TLP	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
V	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03	0.50E+03
XSAT			0.70E+03						0.70E+03			
SUPLY												
PRIMARY	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04
SECONDARY	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04	0.30E+04

Figure 5.1. (Cont.)

```
AECMS                    1.0                                                     1.0

AECMA      0.90     0.90     0.90     0.93     0.90     0.90        0.95     0.95     0.95     0.95     0.95     0.95

TS                       0.50E-01                                                0.50E-01

OR                       0.25E+03                                                0.25E+03

RBS                      0.15E+03                                                0.15E+03

RBA        75.      75.      75.      75.      75.      75.         75.      75.      75.      75.      75.      75.

ANANLT     23.      17.      21.      56.      12.      23.         14.      10.      26.      31.      6.0      9.0

CBNF                     0.00E+00                                                0.00E+00

DAMLOS     1.0      1.0      1.0      1.0      1.0      1.0         1.0      1.0      1.0      1.0      1.0      1.0

DMTTR      12.      12.      12.      12.      12.      12.         12.      12.      12.      12.      12.      12.

FMTTR      3.0      3.0      3.0      3.0      3.0      3.0         3.0      3.0      3.0      3.0      3.0      3.0

FOP                      0.00E+00                                                0.00E+00

PDERP      0.15     0.15     0.15     0.15     0.15     0.15        0.15     0.15     0.15     0.15     0.15     0.15

PRDY       0.90     0.90     0.90     0.90     0.90     0.90        0.90     0.90     0.90     0.90     0.90     0.70

RHO        0.00E+00 0.00E+00 0.30     0.80     0.00E+00 0.00E+00    0.00E+00 0.00E+00 0.25     0.58     0.00E+00 0.00E+00

TOL        0.40E+04 0.40E+04 0.26E+04 0.30E+04 0.40E+04 0.40E+04    0.40E+04 0.26E+04 0.26E+04 0.30E+04 0.40E+04 0.40E+04

TRNLMT     0.10E+03 59.      0.10E+03 0.26E+03 48.      90.         56.      40.      0.10E+03 0.12E+03 24.      36.

XNTBF      6.0      6.0      7.0      7.0      6.0      6.0         8.0      8.0      9.0      10.      8.0      8.0

XRUN

    PRIMARY              97.                                                     43.

    SECONDARY            0.00E+00                                                0.00E+00

XLRUN

    PRIMARY              0.30E+04                                                0.80E+04

    SECONDARY            0.00E+00                                                0.00E+00

TFIX                     24.                                                     24.

IOPTR                      2                                                       2
$EVENT1
AC      =  1.000000    ,  0.0000000E+00,  1.000000    ,  106.0000    ,
 0.0000000E+00,  54.00000    ,  0.0000000E+00,  45.00000    ,  0.0000000E+00,
 100.0000    ,  0.0000000E+00,  43.00000    ,  0.0000000E+00,  62.00000    ,
 0.0000000E+00
$END
$EVENT1
AC      =  1.000000    ,  -0.0000000    ,  -1.000000    ,  140.0000    ,
 0.0000000E+00,  100.0000    ,  0.0000000E+00,  150.0000    ,  0.0000000E+00,
 60.00000    ,  0.0000000E+00,  30.00000    ,  0.0000000E+00,  30.00000    ,
```

Figure 5.1. (Cont.)

```
 0.0000000E+00
$END
$EVENT1
AC       =   1.000000   ,   5.000000   ,   1.000000   ,   106.0000   ,
 0.0000000E+00,   64.00000   ,   0.0000000E+00,   45.00000   ,   0.0000000E+00,
  105.0000   ,   0.0000000E+00,   43.00000   ,   0.0000000E+00,   62.00000   ,
 0.0000000E+00
$END
$EVENT1
AC       =   1.000000   ,   7.500000   ,  -1.000000   ,   140.0000   ,
 0.0000000E+00,   100.0000   ,   0.0000000E+00,   150.0000   ,   0.0000000E+00,
  60.00000   ,   0.0000000E+00,   20.00000   ,   0.0000000E+00,   30.00000   ,
 0.0000000E+00
$END
$EVENT1
AC       =   1.000000   ,   10.00000   ,   1.000000   ,   106.0000   ,
 0.0000000E+00,   64.00000   ,   0.0000000E+00,   45.00000   ,   0.0000000E+00,
  105.0000   ,   0.0000000E+00,   43.00000   ,   0.0000000E+00,   62.00000   ,
 0.0000000E+00
$END
$EVENT1
AC       =   1.000000   ,   12.50000   ,  -1.000000   ,   140.0000   ,
 0.0000000E+00,   100.0000   ,   0.0000000E+00,   150.0000   ,   0.0000000E+00,
  60.00000   ,   0.0000000E+00,   20.00000   ,   0.0000000E+00,   30.00000   ,
 0.0000000E+00
$END
$EVENT1
AC       =   1.000000   ,   24.00000   ,   1.000000   , 12*0.0000000E+00
$END
$EVENT4
FAC      =   4.000000   ,   23.00000   ,  -1.000000   ,   15.00000   ,
  25.00000   ,   42.00000   ,   22.00000   , 2*15.00000
$END
$EVENT5
SMRS     =   5.000000   ,   4.200000   ,  -1.000000   , 9*6.000000
$END
$EVENT6
SPRS     =   5.000000   ,   7.500000   ,  -1.000000   , 6*500.0000
$END
```

Figure 5.1. (Cont.)

5.3 BASE STATUS OUTPUT

Most of the tabular output from AIRWARII occurs in two formats: 1. Status of Aircraft at Primary (Secondary) Bases and 2. Summary Status. It is possible to print these two pages of output for every event. For both outputs, time is in hours.

Status of Aircraft at Bases, an example shown in Fig. 5.2, contains ten columns, the first identifying the aircraft type and the remainder specifying the status of the runways and various queues. The columns are titled and defined as follows.

1. AC TYPE. This is the number identification of each aircraft. There are six rows, each row repeated for both Red and Blue at Primary and Secondary bases. Thus, each column has twenty-four rows, plus four rows for totals.

2. NUMBER IN DAMAGE QUEUE. These are aircraft with battle damage, waiting until space is available in the "damaged under repair" queue.

3. DAMAGED UNDER REPAIR. In this queue are battle-damaged aircraft undergoing repair.

4. NUMBER IN BROKEN QUEUE. Aircraft in this queue experienced system failures and await space in the "broken under repair" queue.

5. BROKEN UNDER REPAIR. These aircraft, suffering system failures, are being repaired. The repair facilities (maximum capacity defined by AMANLT) are shared jointly with the "damaged under repair" queue, but broken aircraft are preferentially placed in this queue. If room is available, then battle damaged aircraft may be included. Once in the queue battle-damaged

AIRWAR EXPECTED VALUE COUNTER-AIR CAMPAIGN 1-MAY-84
CASE- 1

QUEUING STATUS DURING CAMPAIGN
EVENT TYPE = -BLUE LAUNCH A/C
EVENT TIME = 5.50

STATUS OF A/C AT PRIMARY BASES

AC TYPE	NUMBER IN DAMAGE-Q	DAMAGED UNDER REPAIR	NUMBER IN BROKEN-Q	BROKEN UNDER REPAIR	NUMBER IN RESERV	NUMBER IN TURN-AROUND	NUMBER READY	FRACTION RUNWAYS OPEN	SUPPLIES FOR SORTIES
RED									
1	0.0	13.3	16.0	6.4	0.0	5.9	121.8	0.79	2789.0
2	0.0	8.1	9.0	3.7	0.0	3.5	67.9	0.79	2873.0
3	13.2	0.0	41.5	28.0	0.0	57.0	105.0	0.86	2687.0
4	20.0	0.0	43.5	56.0	0.0	22.0	429.7	0.79	2460.0
5	0.0	3.5	6.0	3.3	0.0	2.6	60.6	0.79	2915.0
6	0.0	1.0	9.0	6.0	0.0	4.0	152.9	0.79	2877.0
	33.2	26.0	125.0	103.4	0.0	94.9	937.9		16601.0
BLUE									
1	9.7	5.6	0.0	8.4	0.0	25.2	56.2	0.66	2915.0
2	10.6	2.7	0.0	7.3	0.0	20.7	29.0	0.77	2927.0
3	26.1	1.2	0.0	24.8	0.0	68.5	19.7	0.77	2679.0
4	16.0	8.2	0.0	22.8	0.0	34.4	62.6	0.66	2575.0
5	0.0	2.5	0.0	2.5	0.0	8.8	41.0	0.66	2381.0
6	0.0	0.5	0.0	5.4	0.0	21.6	61.1	0.66	2971.0
	62.4	20.7	0.0	71.1	0.0	179.1	269.6		17046.0

STATUS OF A/C AT SECONDARY BASES

AC TYPE	NUMBER IN DAMAGE-Q	DAMAGED UNDER REPAIR	NUMBER IN BROKEN-Q	BROKEN UNDER REPAIR	NUMBER IN RESERV	NUMBER IN TURN-AROUND	NUMBER READY	FRACTION RUNWAYS OPEN	SUPPLIES FOR SORTIES
RED									
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
BLUE									
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0

Figure 5.2. Base Status

aircraft are never removed before their repair is complete to make room for broken aircraft, unless the user specifies IOPTR(ID)=3.

6. NUMBER IN RESERVE. This queue contains aircraft waiting to be admitted to the turn-around queue. It includes those repaired, those recovered without damage or system failure, and those that have been added by an aircraft reinforcement event.

7. NUMBER IN TURN-AROUND. This queue contains aircraft undergoing refueling and re-arming. When the task is completed, they will be moved to the ready queue.

8. NUMBER READY. All aircraft in this queue are armed and fueled. Aircraft must reach this queue before they may be used in a mission.

9. FRACTION RUNWAYS OPEN. This is the fraction of the original number of takeoff lengths available to each type of aircraft at this time.

10. SUPPLIES FOR SORTIES. This column lists the number of sorties for which supplies are available, for each type of aircraft. Implicitly included are fuel, arms, etc.

5.4 SUMMARY STATUS OUTPUT

At each event, it is possible to have as output a summary status of the campaign to this point in time. This summary output, shown in Fig. 5.3, concerns mission performance and survivability. The output contains twelve columns, listed and defined as follows:

AIRWAR EXPECTED VALUE COUNTER-AIR CAMPAIGN 1-MAY-84
CASE- 1

QUEUING STATUS DURING CAMPAIGN
EVENT TYPE = -BLUE LAUNCH A/C
EVENT TIME = 5.50

SUMMARY STATUS -

AC TYPE	TOTAL A/C INFLIGHT	TOTAL SORTIES FLOWN	TOTAL DAMAGED BYND-RPR	TOTAL KILLED ON GRND	TOTAL KILLED IN AIR	TOTAL UNABLE TO LAND	TOTAL A/C SURVIVING	TOTAL A/C KILLED	FRACTION A/C KILLED*	TOTAL-BOMBS-DROPPED NUMBER	TOTAL-BOMBS-DROPPED FRACT**
RED											
1	69.0	122.0	3.1	1.3	31.2	0.0	252.36	35.6	0.12	125.4	0.26
2	54.0	73.0	1.9	0.8	19.1	0.0	146.26	21.7	0.13	0.0	0.00
3	22.0	291.0	2.4	0.1	17.8	0.0	266.67	20.3	0.07	0.0	0.00
4	91.0	449.0	3.9	1.2	27.8	0.0	662.25	32.8	0.05	0.0	0.00
5	36.0	49.0	0.8	0.6	6.6	0.0	112.00	8.0	0.07	0.0	0.00
6	52.0	71.0	0.2	1.2	1.7	0.0	224.68	3.1	0.01	0.0	0.00
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	344.0	1055.0	12.2	5.2	104.2	0.0	1664.4	121.6	0.07	125.4	0.26
BLUE											
1	0.0	65.0	2.8	1.1	31.1	0.0	105.08	34.9	0.25	100.5	0.20
2	0.0	73.0	2.4	0.8	26.6	0.0	70.29	29.7	0.30	57.3	0.20
3	66.0	255.0	5.0	0.8	42.9	0.0	206.25	48.7	0.19	0.0	0.00
4	122.0	305.0	4.4	0.2	34.5	0.0	265.98	39.0	0.13	0.0	0.00
5	0.0	19.0	0.5	0.5	4.3	0.0	54.79	5.2	0.09	0.0	0.00
6	0.0	29.0	0.1	0.7	0.7	0.0	88.54	1.5	0.02	0.0	0.00
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	188.0	766.0	15.1	4.1	140.0	0.0	790.9	159.1	0.17	157.9	0.20

* BASED ON THE INITIAL NUMBER OF AC AVAILABLE
** BASED ON THE TOTAL NUMBER OF SORTIES FLOWN

Figure 5.3. Summary Status

1. AC TYPE. This column contains six rows for both Red and Blue. Each row identifies an aircraft type to be associated with the information in each of the following eleven columns.

2. TOTAL AIRCRAFT INFLIGHT. This lists the total aircraft of each type that are in the air at this particular time.

3. TOTAL SORTIES FLOWN. This number tallies all aircraft that have landed or been killed in the air.

4. TOTAL DAMAGED BEYOND REPAIR. These aircraft have been hit, have returned to base, and yet are so damaged that they are no longer in the game.

5. TOTAL KILLED ON GROUND. In any bombing event, aircraft remaining on the ground may be subject to destruction. Those that are killed in this manner are tallied here.

6. TOTAL KILLED IN AIR. Aircraft killed in any defensive zone are tallied here.

7. TOTAL UNABLE TO LAND. Should both primary and secondary airbases be closed down at the time when aircraft recover, they must choose an alternate landing strip. If this is the case, they are considered out of the game and are tallied here.

8. TOTAL AIRCRAFT SURVIVING. Those aircraft that have not been killed on the ground or in the air or damaged beyond repair.

9. TOTAL AIRCRAFT KILLED. The sum of columns 4, 5, and 6.

10. FRACTION AIRCRAFT KILLED. The fraction of aircraft killed relative to the initial number available and reinforcements.

11. TOTAL-BOMBS-DROPPED NUMBER. The total number of bombs released by the attacker.

12. TOTAL-BOMBS-DROPPED FRACT. The ratio of actual bombs dropped to the amount that could have been dropped had all sorties been successful.

5.5 SPECIAL EVENT OUTPUTS

In addition to the above output, possibly printed at launch and recovery events, there is output associated with other events.

5.5.1 Supply Reinforcements

Reinforcement of aircraft or sortie supplies is reflected in the first base status output following the reinforcement event. Aircraft are added to NUMBER IN RESERVE in column 6. Supplies are added to SUPPLIES FOR SORTIES in column 10.

5.5.2 SAM Reinforcements

At the time of each SAM reinforcement (for KPRNT greater than -1 or for game time greater than TPRNT) output will appear listing launch vehicle type, defensive zone where launcher is located, and number of SAMs now available to each launcher. Figure 5.3 is an example.

```
***AIRWAR***  EXPECTED VALUE COUNTER-AIR CAMPAIGN            5-MAR-84
CASE-  1

QUEUING STATUS DURING CAMPAIGN
EVENT TYPE  =        -BLUE SAM REINFORCEMENTS
EVENT TIME  =       4.20


NUMBER OF SAMS PER LAUNCH VEHICLE

  VEHICLE     SHORAD       BSAM      ASAM
     TYPE       ZONE       ZONE      ZONE

        1        9.0        8.0      10.0
        2        9.0        8.0      10.0
        3        9.0        8.0      10.0
```

Figure 5.4. SAM Reinforcements

5.5.3 Attrition By Defensive Zones

This output is listed during every battle event for KPRNT greater than -1, or for times greater than TPRNT. It lists the aircraft attrited by each defensive zone and the number remaining. Aircraft are considered attrited if they have been hit, but not necessarily killed. Figure 5.5 is an example of this output.

RED AIRCRAFT ATTRITION BY BLUE DEFENSIVE ZONE *

A/C TYPE	A/C ENTERING DEFENSIVE ZONE	A/C ATTRITED IN SHORAD ZONE	A/C ATTRITED IN BSAM ZONE	A/C ATTRITED IN AI ZONE	A/C ATTRITED IN ASAM ZONE	A/C LEAVING
1	89.0	0.3	0.2	35.1	0.6	[illegible]
2	54.0	0.2	0.1	23.1	0.5	30.2
3	22.0	0.1	0.1	3.0	0.2	18.7
4	91.0	0.3	0.2	10.6	[illegible]	78.9
5	36.0	0.1	0.1	6.6	0.3	28.9
6	52.0	0.1	1.0	0.0	2.5	48.7
	344.0	1.2	1.6	81.4	4.6	255.2

* NOTE: ATTRITED AIRCRAFT INCLUDES THOSE THAT ARE HIT AND DAMAGED OR KILLED, AND THUS NO LONGER IN THE GAME.

Figure 5.5. Aircraft Attrition

5.5.4 Weapons Delivered by Defensive Zones

This output will immediately follow ATTRITION BY DEFENSIVE ZONE data. It details the bombs dropped by each aircraft type into four defensive zones and total bombs dropped. Figure 5.6 is an example.

RED BOMBS DROPPED IN BLUE DEFENSIVE ZONE

A/C TYPE	BOMBS DROPPED IN SHORAD ZONE	BOMBS DROPPED IN BSAM ZONE	BOMBS DROPPED IN AI ZONE	BOMBS DROPPED IN ASAM ZONE	BOMBS DROPPED TOTAL
1	0.0	0.0	108.3	103.5	211.8
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	108.3	103.5	211.8

Figure 5.6. Weapons Delivered

5.6 PLOT DATA OUTPUT (TAPE7)

AIRWAR also produces a file of data necessary to create graphic output. If multiple cases are run, each will terminate on this tape with 9999.

OUTPUT FORMAT OF DATA TAPE 7

RECORD 1 (A9,I3)	DATE = DATE OF AIRWAR RUN KASE = CASE NUMBER
RECORD 2 (F10.2,I3)	TIME = GAME TIME IREC = RECORD TYPE
RECORD 3 (12F10.2)	ONE OF THREE -IREC- TYPES

IJ = IJ-TH A/C TYPE
ID = IDENTIFICATION (1 = RED, 2 = BLUE)
IPS = BASE ID (1 = PRIMARY, 2 = SECONDARY)

TYPE 1 (FROM SUBROUTINE -AIRWAR-)

RUNWAY(IJ,ID,IPS) = FRACTION RUNWAYS OPEN
TOTFLT(IJ,ID) = TOTAL AIRCRAFT IN FLIGHT
TOSORT(IJ,ID) = TOTAL SORTIES FLOWN
TKILL(IJ,ID) = TOTAL AIRCRAFT KILLED
TGND(IJ,ID) = TOTAL AIRCRAFT KILLED ON GROUND
TOLOST(IJ,ID) = TOTAL AIRCRAFT LOST IN AIR
TWEAP(IJ,ID) = TOTAL BOMBS DROPPED
FKILL(IJ,ID) = FRACTION OF AIRCRAFT KILLED BY TYPE
FRACTN(ID) = FRACTION OF TOTAL AIRCRAFT KILLED

TYPE 2 (FROM SUBROUTINE -BATTLE-)

SIDE = WHO SUFFERS ATTRITION (1. = RED, 1 = BLUE)
AND DELIVERS WEAPONS
XLOST(IJ,IA) = NUMBER OF AIRCRAFT ATTRITED BY TYPE

IA =
1 - SHORAD
2 - BARRIER SAMS
3 - DEFENDING AIRCRAFT
4 - AREA SAMS

WEAPS(IJ,IPS) = NUMBER OF WEAPONS DELIVERED TO PRIMARY AND SECONDARY AIR BASES

TYPE 3 (FROM SUBROUTINE -LNCHR-)

SIDE = WHO GENERATES SORTIES (1. = RED, 1 = BLUE)
SORT(IJ,IPS) = SORTIES GENERATED

RECORD 4 TO LAST - 1 PAIRS OF RECORDS AS DEFINED BY RECORD 2 AND RECORD 3 ABOVE

RECORD -LAST-
(F10.2) ENDMK = 9999.

5.7 INTERACTIVE GRAPHICS FROM AIRPLT

Program AIRPLT uses TAPE7 to create a number of graphs which detail the results of the Red/Blue conflict in AIRWARII. All plots show game time on the x-axis and various selected information on the y-axis. With the exception of total ratio of attrition, all plots include six aircraft types with a legend to identify each type.

AIRPLT asks the user which plots are desired and whether these plots are to be reviewed interactively before hardcopy, or automatically produced as hardcopy.

The first message on the Tektronix screen is:

```
THE STANDARD PLOT GROUP IS AS FOLLOWS:
    RATIO OF ATTRITION RATES
    TOTAL A/C KILLED
    TOTAL WEAPONS DELIVERED
    TOTAL SORTIES GENERATED
DO YOU WANT STANDARD HARDCOPY PLOTS
WITH NO INTERACTIVE WORK? (Y/N)
```

A response of Y will produce automatic hardcopy of these four plots for both Red and Blue. No further interactive responses are required, even if TAPE7 contains multiple cases.

A response of N will summon the next message :

```
PLOTS ARE AVAILABLE ON THE FOLLOWING TOPICS :
(ALL ARE VERSUS TIME AND CONTAIN 6 A/C TYPES)
1 RATIO OF ATTRITION RATES (Y/N)(Red fraction killed/Blue
                                 fraction killed)
2 TOTAL A/C KILLED (Y/N)
```

3 TOTAL WEAPONS DELIVERED (Y/N)

4 TOTAL SORTIES GENERATED (Y/N)(From primary + secondary bases)

5 TOTAL A/C ATTRITION FROM AIRBORNE KILLS (Y/N)

6 TOTAL A/C ATTRITION FROM GROUND KILLS (Y/N)

7 A/C ATTRITED BY DEFENDING ZONES (Four plots, one from each zone)
SHORAD, BARRIER SAM,
INTERCEPTING A/C, AREA SAM (Y/N)

8 WEAPONS DELIVERED TO PRIMARY AND (Two plots, one for each base)
SECONDARY BASES (Y/N)

9 RUNWAYS OPEN AT PRIMARY AND (Two plots, one for each base)
SECONDARY BASES (Y/N)

10 SORTIE GENERATION AT PRIMARY AND (Two plots, one for each base)
SECONDARY BASES (Y/N)

As each line appears it prompts the user -?-. An appropriate response is required to bring up the next query.

After the ten plots have been offered, the screen will ask :

DO YOU WANT RED, BLUE, OR ALL? (R/B/A)

The user may specify whether he wishes to see only Red data, only Blue data, or both Red and Blue.

Then the screen asks :

AS EACH PLOT APPEARS YOU MAY DECIDE TO HARDCOPY
WOULD YOU PREFER THE SELECTED PLOTS HARDCOPIED
WITH NO INTERACTIVE WORK (Y/N)

An answer of Y will signal AIRPLT to make automatic hardcopy of all selected plots for this case and for any following cases that TAPE7 may contain. Upon completion of the last case, AIRPLT will exit. This option differs from the standard plot option offered earlier, as it may include any combination of plots.

Answering N to this question will enable the user to review plots interactively and decide individually which to hardcopy.
As each plot appears on the screen, a message is written on the extreme lower edge :

HARDCOPY WANTED? PRESS -COPY-, WHEN
CURSOR HALTS, PRESS -RETURN-
NEXT PLOT? PRESS -RETURN-

To secure hardcopy, the user must press the "copy" switch on his Tektronix terminal. A cursor will appear and sweep the screen horizontally from top to bottom. RETURN should not be pressed until the cursor has halted.

If the user decides he wants no hardcopy, he presses RETURN to summon the next plot.

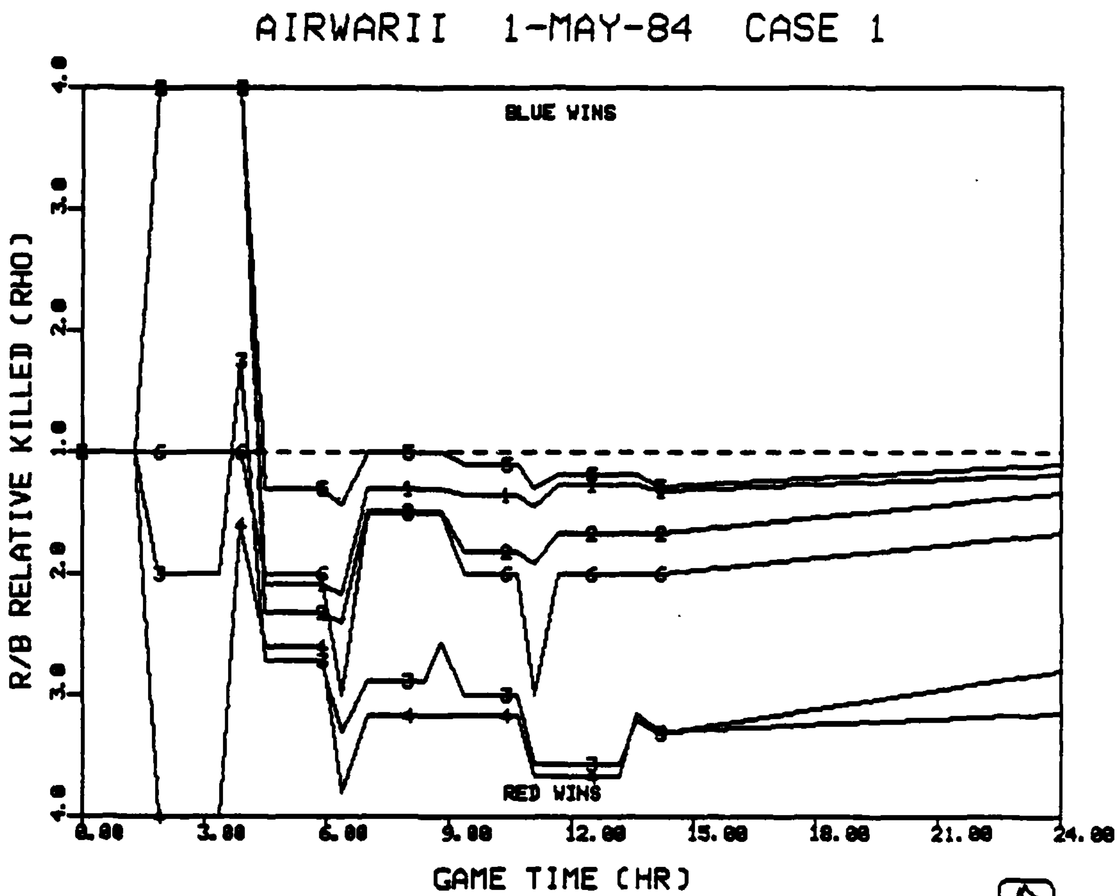
After the last graph has been reviewed a message will appear :

DO YOU WANT TO SEE MENU AGAIN (Y/N)

Should the user wish to see an additional plot of the current case, he should respond Y. The menu will reappear, enabling new or repeat selections.

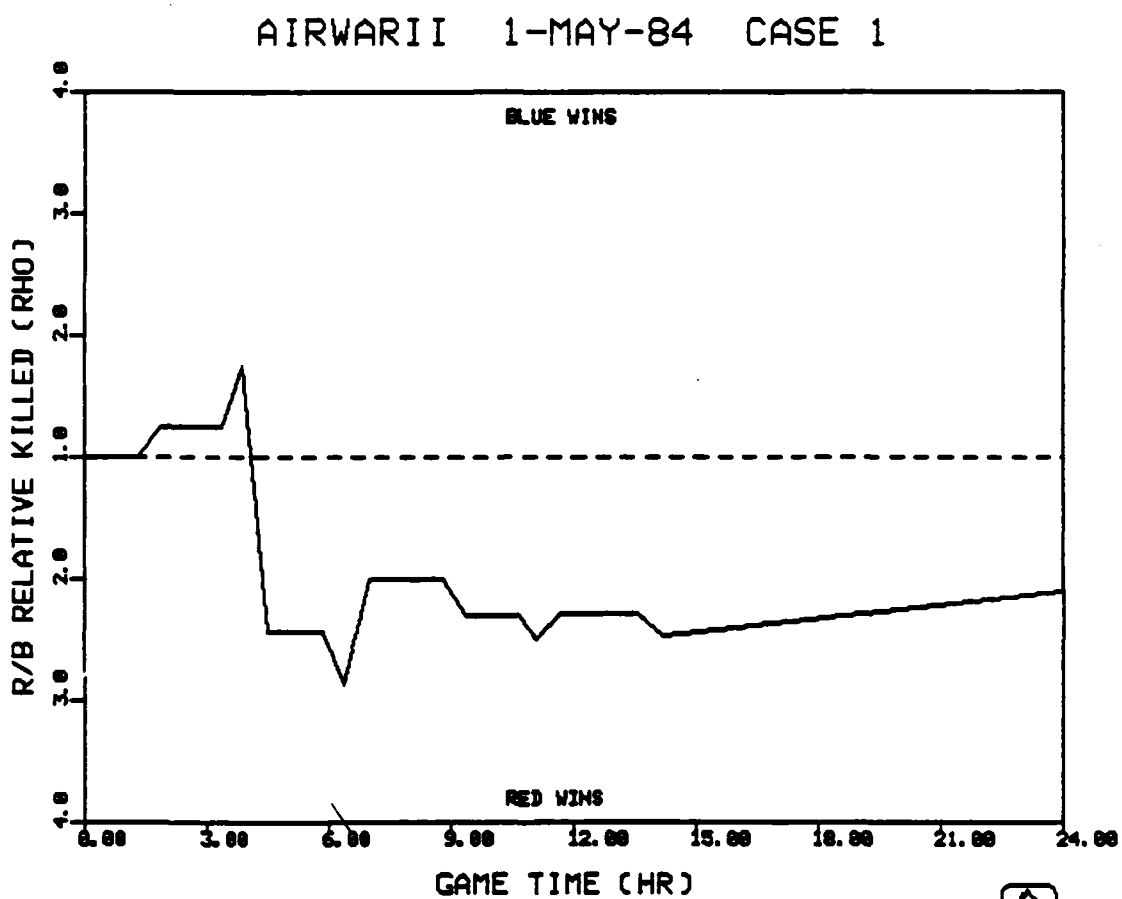
If the user answers N, AIRPLT reads the next case and offers the menu again. Failing to find a new case, the program will exit.

Examples of plots produced by selecting [1 RATIO OF ATTRITION RATES; RED] are shown in Fig. 5.7.



(a) For each aircraft type

Figure 5.7. Example Graphics Output: Ratio of Attrition Rates



(b) For all aircraft

Figure 5.7. (Cont.)

APPENDIX A
SUBROUTINE FLOWCHARTS

The following flowcharts describe the logic of the major subroutines in AIRWARII. No equations are listed here, as these illustrations serve only to guide the user through the basic program flow.

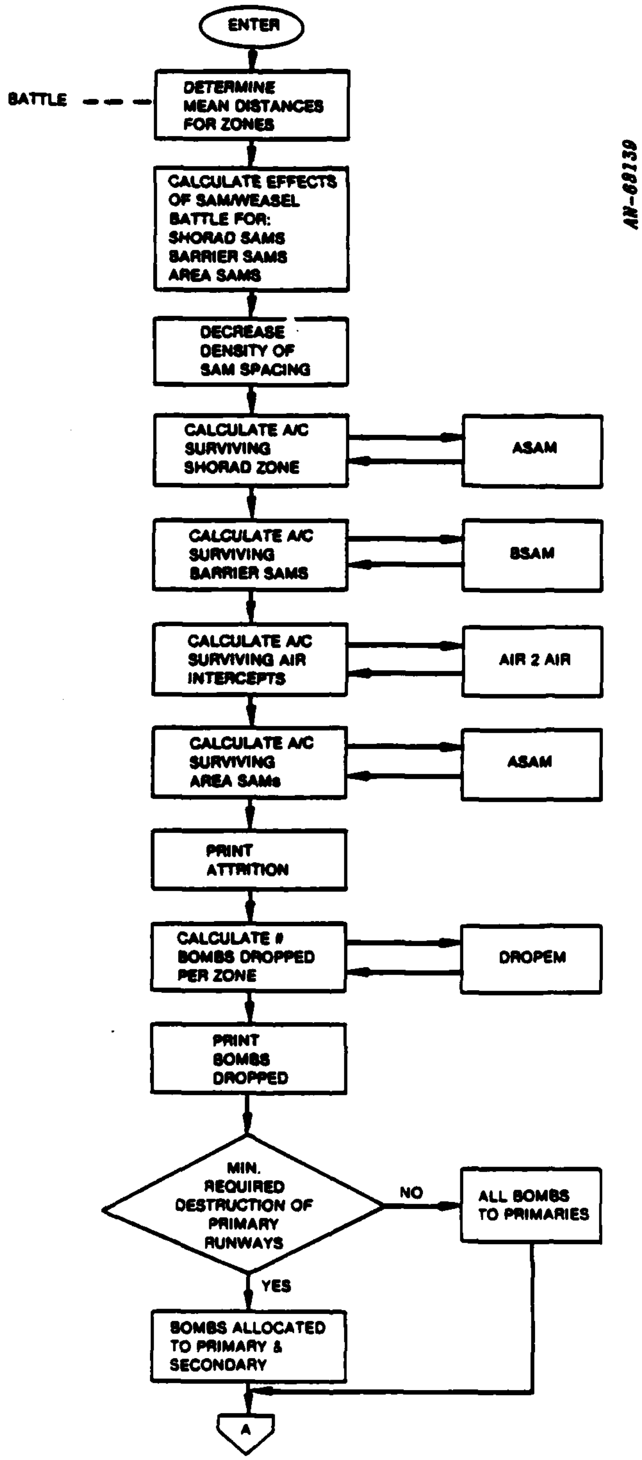


Figure A.1. Subroutine BATTLE

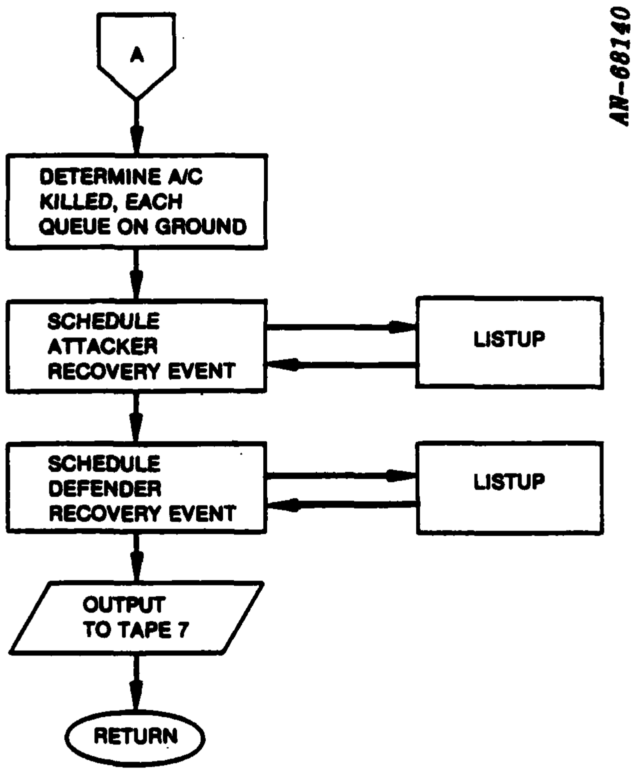


Figure A.1. (Cont.)

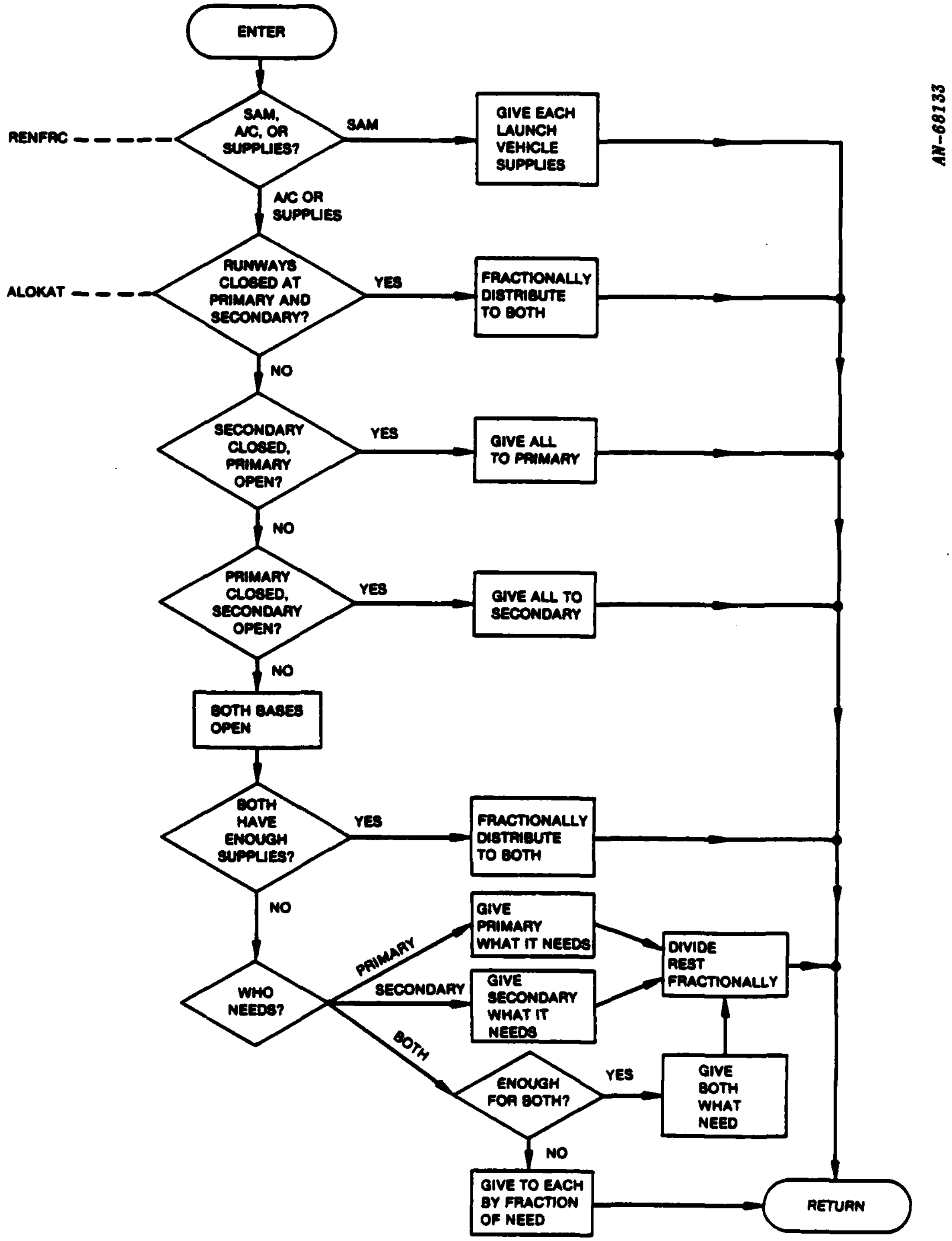


Figure A.2. Subroutine RENFRC

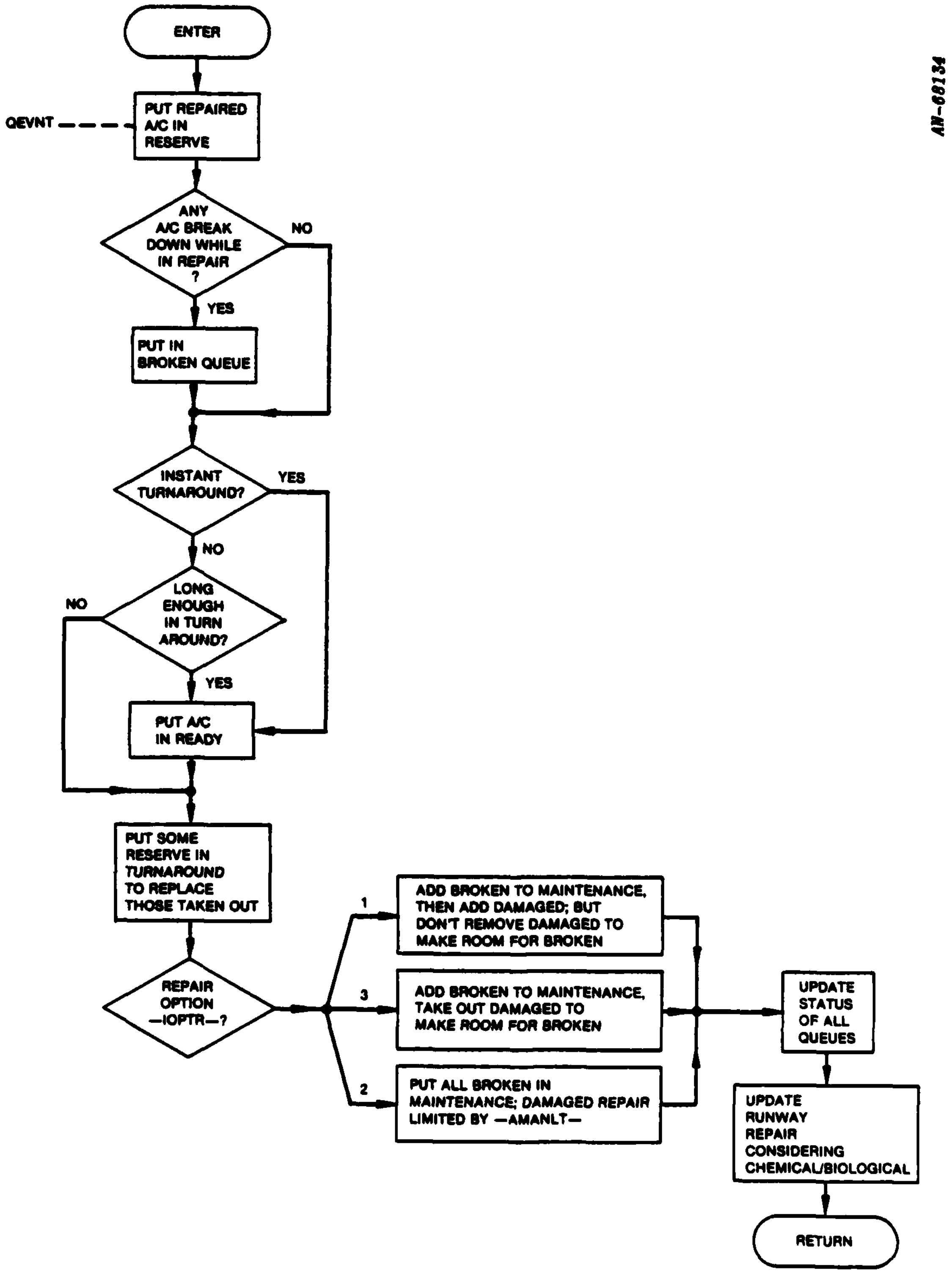


Figure A.3. Subroutine QEVNT

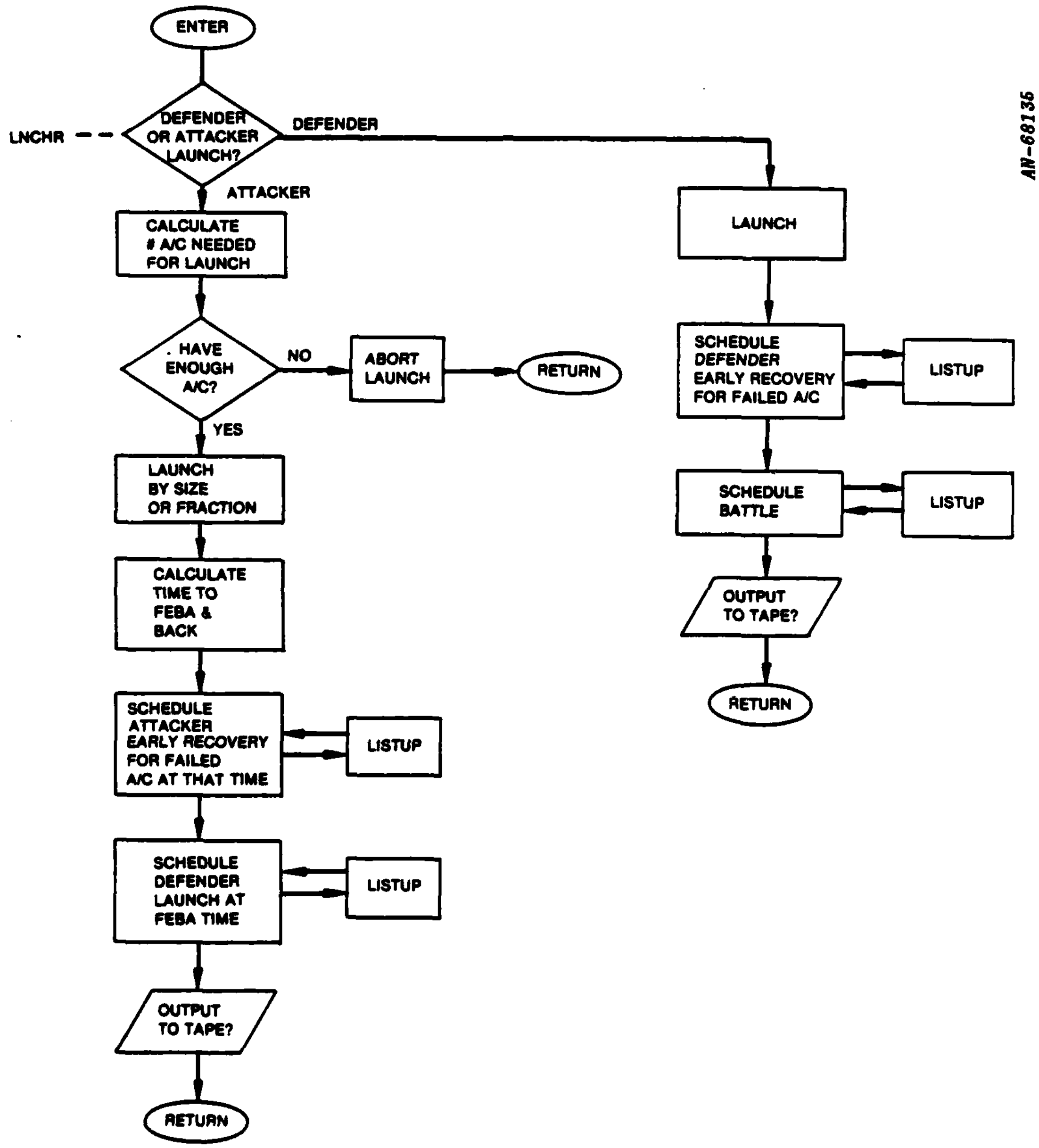


Figure A.4 Subroutine LNCHR

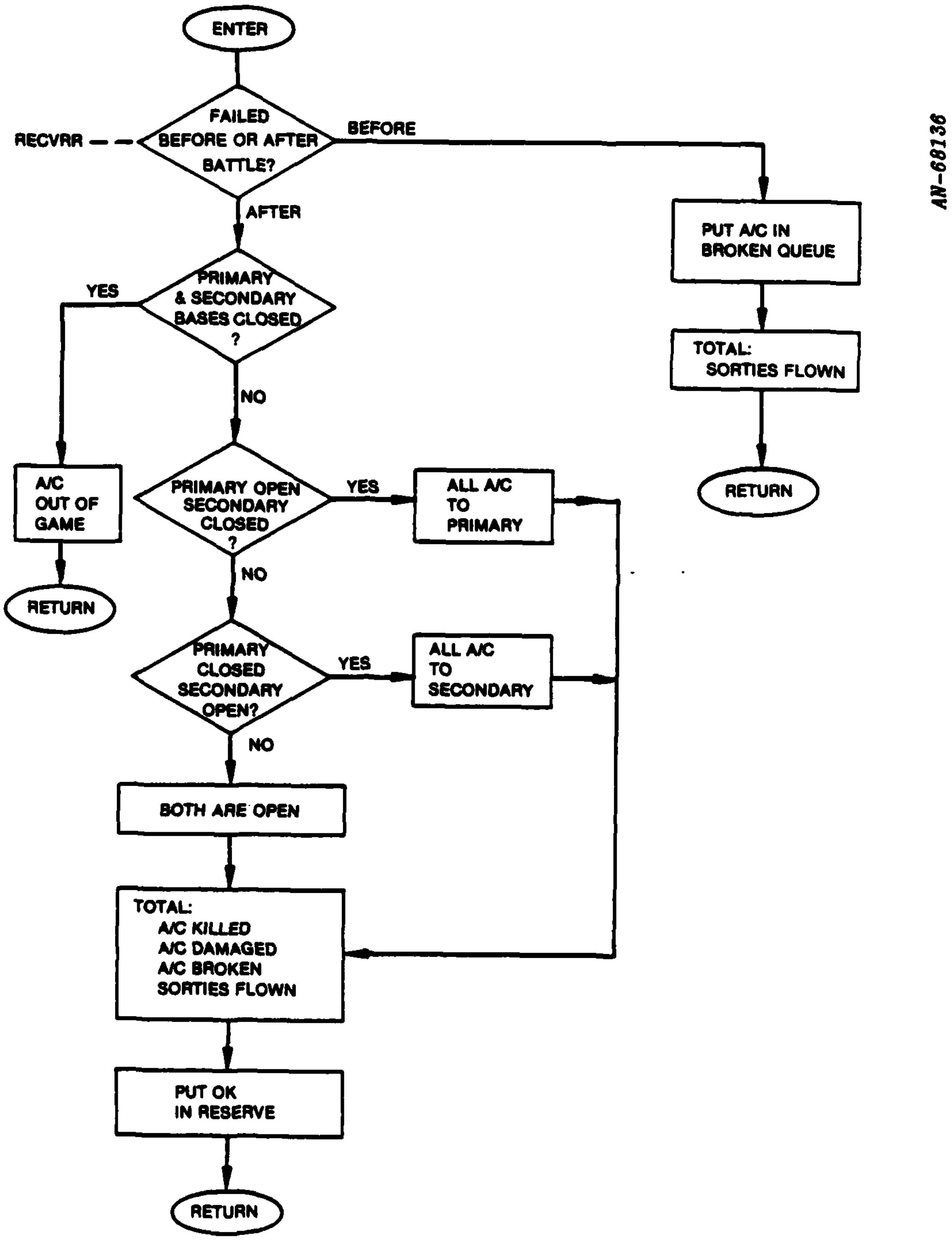


Figure A.5. Subroutine RECVRR

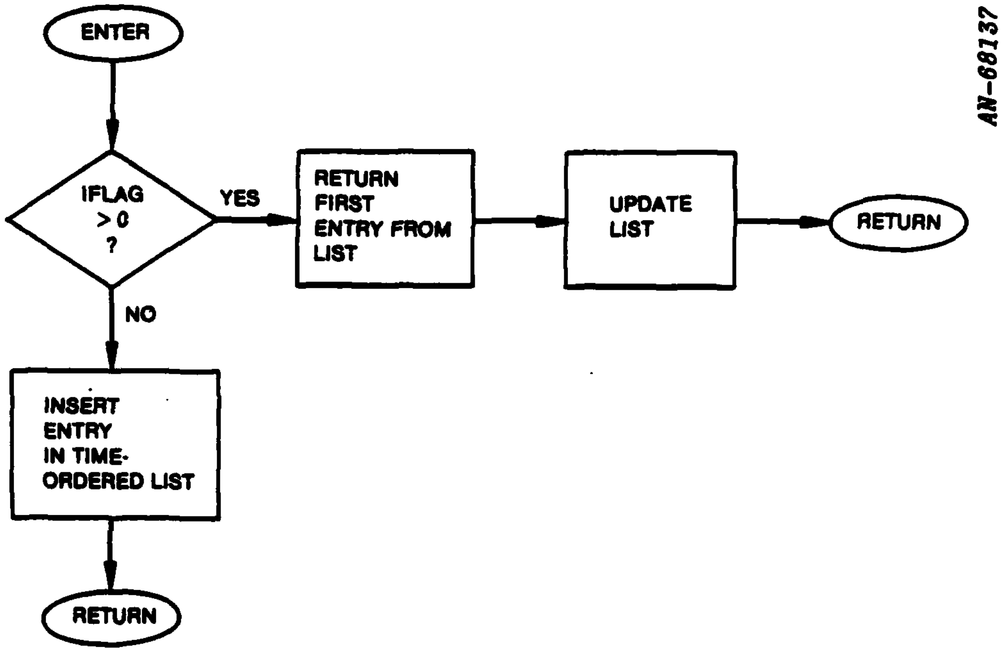


Figure A.6. Subroutine LISTUP

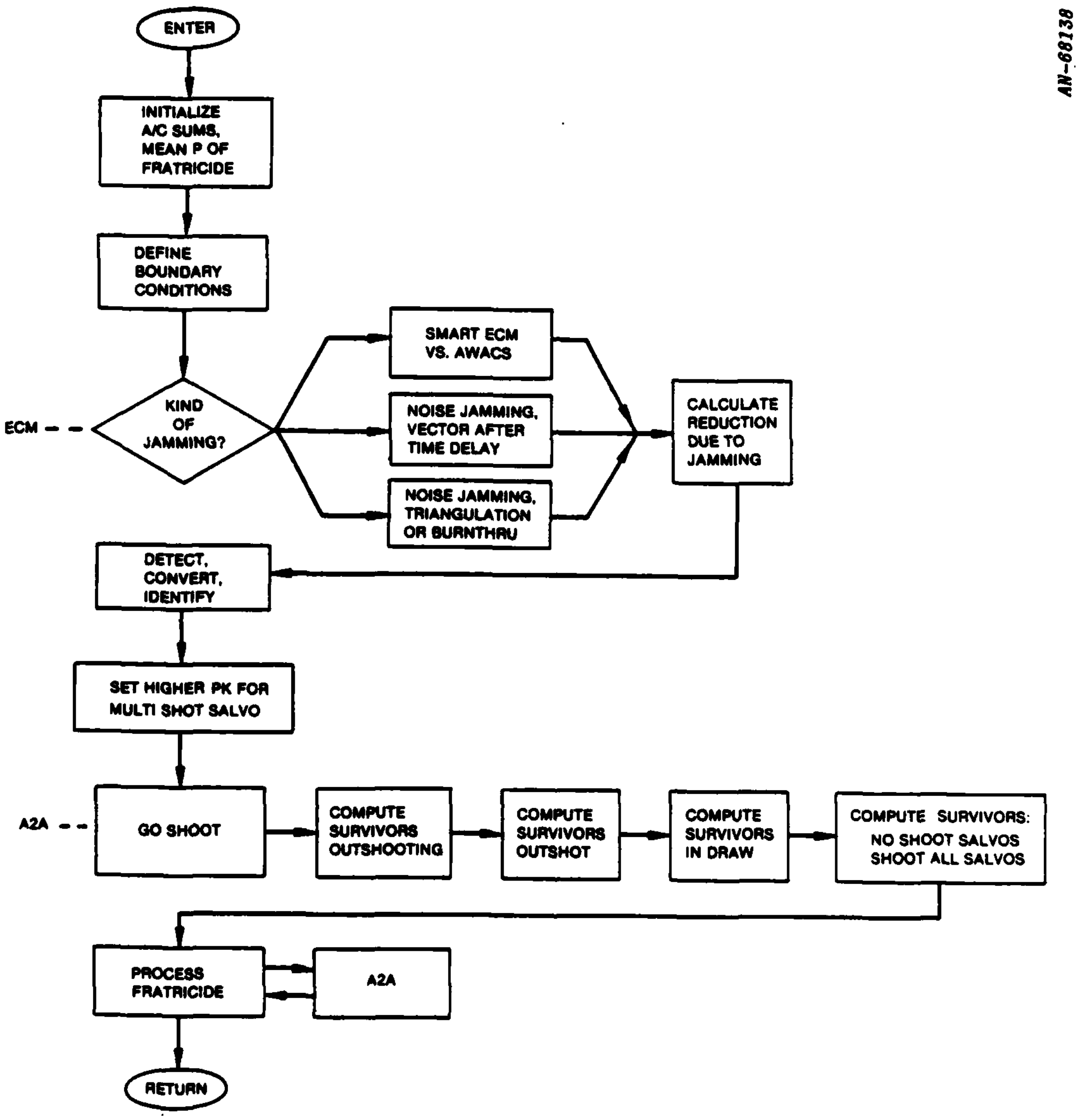


Figure A.7. Subroutine AIR2AIR

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APPENDIX B

DETAILED SUBROUTINE DESCRIPTIONS

This appendix is a detailed presentation of equations and logic supporting AIRWARII doctrine.

B.1 SUBROUTINE A2A

Subroutine A2A returns to AIR2AIR the number of aircraft emerging from a battle of two aircraft types, each loaded with up to three missile types. It does this by solving a matrix of possible survivals after the firing of each salvo, of which three are possible.

The matrix has this form:

		Red K Salvos Fired			
		0	1	2	3
Blue	0	*	*	*	*
L	1	*	*	*	*
Salvos	2	*	*	*	*
Fired	3	*	*	*	*

Each matrix point represents a state at which a number of missiles has been fired; e.g., at K=1, L=2, Red has fired one missile while Blue has fired two. Then, a fraction of the number of aircraft arriving at this state may go to each of the following three states: K=2, L=2, if Red outshoots; K=1, L=3, if Blue outshoots; and K=2, L=3, if both shoot before they are killed.

The number going to each state is directly proportional to the probability of outshoot and the probability of detection and conversion. In addition, aircraft which fail to detect and convert, and are not detected and converted upon by the adversary, go to the next K=L point in the matrix.

The number of survivors after all salvos have been expended is the sum of those launching all salvos and launching no salvos (those that forever fail to detect, etc.) who survive their opponent's salvos.

The evaluation of the node $(k+1, \ell+1)$ determines, for computational simplicity, from where each of the survivors came. Thus, the evaluation at node $(k+1, \ell+1)$ evaluates the transitions from nodes $(k, \ell+1)$, $(k+1, \ell)$ and (k, ℓ), which are respectively, Red outshooting, Red outshot, and Red in a draw.

For each node of the matrix the following evaluations are made:

$$Q_{RB_{(k,\ell)}} = 1 - P_{R_{(k,\ell)}} - P_{B_{(k,\ell)}}$$

where

Q_{RB} = probability that neither Red or Blue has outshoot advantage

P_R = probability Red outshoots Blue

P_B = probability Blue outshoots Red

k = index of Red salvo fired

ℓ = index of Blue salvo fired

Equations are shown for Red, but Blue is treated the same, of course. Here are the Red survivors outshooting:

$$X_{NR1} = P_{R_{(k,\ell+1)}} \cdot X_{NR_{(k,\ell+1)}} \cdot P_{DRB_{(k)}}$$

where

X_{NR1} = expected number of Reds outshooting

X_{NR} = number of Reds before beginning matrix

P_{DRB} = probability of detection/conversion/correct ID, Red or Blue

The Red survivors who were outshot but survived are determined in the following manner:

$$X_{NRT} = X_{NR_{(k+1,\ell)}} \cdot P_{B_{(k+1,\ell)}} \cdot P_{DBR_{(\ell)}}$$

where

X_{NRT} = number of Red in transition from one state to another

P_B = probability Blue outshoots Red

P_{DBR} = probability of detection/conversion/correct ID, Blue on Red

ℓ = Blue salvo

$k+1$ = next Red salvo

If $X_{NRT}>0.0001$,

$$X_{NR2} = X_{NRT} \cdot \left(1 - P_{KB_{(\ell+1)}}\right)^{\text{integer}\left(\frac{X_{NB1}}{X_{NRT}}\right)} \left(1 - P_{KB_{(\ell+1)}} \left(\frac{X_{NB1}}{X_{NRT}} - \text{integer}\left(\frac{X_{NB1}}{X_{NRT}}\right)\right)\right)$$

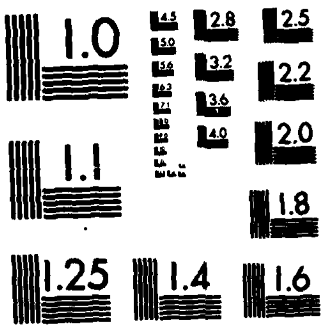
If $X_{NRT} \leq 0.0001$,

$$X_{NR2} = 0.0$$

AD-A144 120 AIRWAR II USER'S MANUAL(U) GENERAL RESEARCH CORP SANTA BARBARA CA J E HERTEL ET AL. 17 APR 84 GRC-CR-1-1091 F33615-81-C-0108 2/2

UNCLASSIFIED F/G 5/9 NL

END



where

X_{NR2} = number of Reds surviving who were outshot

P_{KB} = probability of kill per salvo, Blue on Red

X_{NB1} = expected number of Blues outshooting

The same procedure is followed for Blue, yielding X_{NB2}.

In addition to outshooting and being outshot, there are other survivors, those of a draw, who must detect and convert on each other. Therefore,

$$X_{NBT} = X_{NB_{(k,\ell)}} \cdot Q_{RB_{(k,\ell)}} \cdot P_{DBR_{(\ell)}} \cdot P_{DRB_{(k)}}$$

$$X_{NRT} = X_{NR_{(k,\ell)}} \cdot Q_{RB_{(k,\ell)}} \cdot P_{DRB_{(k)}} \cdot P_{DBR_{(\ell)}}$$

where

X_{NRT} = number of Red in transition from one state to another

Q_{RB} = probability that neither Red or Blue has outshoot advantage

If $X_{NRT}>0.0001$

$$X_{NR3} = X_{NRT}\left(1. - P_{KB_{(\ell+1)}}\right)^{\text{integer}\left(\frac{X_{NBT}}{X_{NRT}}\right)}$$

$$\cdot \left(1. - P_{KB_{(\ell+1)}}\left(\frac{X_{NBT}}{X_{NRT}} - \text{integer}\left(\frac{X_{NBT}}{X_{NRT}}\right)\right)\right)$$

where

X_{NR3} = number of Red survivors of a draw

$\ell+1$ = index of next Blue shot

Blue undergoes similar evaluation for X_{NB3}, the number of Blue survivors in a draw.

There is a further residual of those aircraft that do none of the above; the fraction of aircraft that never detect and convert and are never detected and converted upon. This is the complement of all the above paths from the node (k,ℓ). Thus,

$$F_{LOST} = 1 - P_{B_{(k,\ell)}} \cdot P_{DBR_{(k,\ell}} - P_{R_{(k,\ell}} P_{DRB_{(k,\ell)}} - Q_{RB_{(k,\ell)}} \cdot P_{DRB_{(k,\ell)}} \cdot P_{DBR_{(k,\ell)}}$$

and $X_{NRL} = X_{NR_{(k,\ell)}} \cdot F_{LOST}$

where

F_{LOST} = fraction of aircraft "lost"

X_{NRL} = Red aircraft lost

Blue undergoes a similar fate.

Having considered all possible outcomes of salvo exchange at surrounding nodes, the program sums the surviving numbers of Red and Blue which enter from each adjoining node, the calculations for which were done above.

$$X_{NR_{(k+1,\ell+1)}} = X_{NR1} + X_{NR2} + X_{NR3} + X_{NRL}$$

where

$X_{NR_{(k+1,\ell+1)}}$ = number of Reds entering this node of the matrix.

Then $X_{NR_{(k+1,\ell+1)}}$ and $X_{NB_{(k+1,\ell+1)}}$ set the starting number of Reds and Blues for the next round of salvos and the program loops back to process the next node of the matrix.

At the end of the battle, we must determine those survivors who have unloaded various numbers of salvos and survived.

$$A = \sum_{k\ell=0}^{2} \left(X_{NR_{(k\ell,3)}} \left(1.-P_{R_{(k\ell,3)}} \cdot P_{DRB_{(k\ell)}}\right) + X_{NR_{(3,k\ell)}} \cdot \left(1 - P_{B_{(3,k\ell)}} \cdot P_{DBR_{(k\ell)}}\right)\right)$$

where

A = Red survivors who did not shoot all salvos

$k\ell$ = node of matrix

Then the total number of survivors is

$$X_{NRS} = A + X_{NR(3,3)}$$

where

$X_{NR(3,3)}$ = Reds who survived after firing all three salvos

The number of Blue survivors is calculated in similar fashion and both values are returned to subroutine AIR2AIR.

B.2 SUBROUTINE ECM

The electronic countermeasures routine models degradation of radar signals by jammers through the return of two reduction factors: RF, a reduction in the number of detections (X_N) per battle, and RFDC, a reduction in the ability to detect and convert (P_{DC}).

Three jammer types may be implemented, dependent on the user input K_{CALC}:

Smart ECM versus AWACS

K_{CALC} = 0

T_{DLA} = 0 (Time delay)

N_{RF} = 1 (reduction factor, overload of detection capabilities)

A_{DJ} = input value AECMS (adjustment for ECM on AWACS)

Noise jamming - (AI vectored after a time delay)

K_{CALC} = 1

T_{DLA} = input value (AI vectored after this delay)

N_{RF} = 1

A_{DJ} = 1

Noise jamming - (AI vectored after triangulation time)

K_{CALC} = 2 (delay or burnthrough)

T_{DLA} = input value

A_{DJ} = 1

$$N_{RF} = \text{Integer}\left(\left(\frac{D_{R(1d)} - R_{BS(1d)}}{R_{BD(id,1d)}}\right) + 1\right)$$

where

D_R = detection radius of AWACS

R_{BS} = range for burnthrough of AWACS

R_{BD} = range of detection for air intercept

ld = who's defending

id = defender aircraft type

All three jammers then utilize the following equations:

$$T_C = \frac{R_{P(ia,la)} - R_{S(id,ld)}}{V_{(ia,la)}}$$

where

T_C = time in coverage

R_P = attacker range of penetration

R_S = defender standoff range from FEBA

V = attacker velocity

ia = attacker aircraft type

id = defender aircraft type

la = attacker side (1 Red, 2 Blue)

ld = defender side (1 Red, 2 Blue)

and

$$T_T = 2 \cdot \left(\frac{R_{P(ia,la)} + R_{B(ia,la,ips)}}{V_{(ia,la)}} \right)$$

where

T_T = maximum time of flight for attackers

R_B = range to attacker base

ips = designates primary or secondary base

Distances to primary and secondary bases are examined and the greater one chosen to calculate the maximum time of flight to battle and back.

$$R_{F1} = \frac{1}{N_{RF}}$$

where

R_{F1} = reduction factor for unseen attackers

$$R_{F2} = \left(\frac{T_T - T_{DLA}}{T_{ENG_{(id,ld)}}}\right)\left(\frac{X_{SAT_{(ld)}}}{X_{NASUM}}\right)$$

where

R_{F2} = reduction factor for positive identification

T_{ENG} = average time for engagement of defender's type id aircraft

X_{SAT} = saturation limit of defender's AWACS

X_{NASUM} = number of attackers

$$R_{F3} = \frac{T_C - T_{DLA}}{T_{ENG_{(id,ld)}}}$$

where

R_{F3} = reduction factor for positive identification

$R_{F_{(1a)}}$ = minimum of $(1.0, R_{F1}, R_{F2}, R_{F3})$

$R_{F_{(1a)}}$ = maximum of $(R_{F_{(1a)}}, 0)$

where

$R_{F_{(1a)}}$ = reduction in number of attackers defender detects

$$R_{F_{(1d)}} = 1$$

where

$R_{F_{(1d)}}$ = reduction in number of defenders attacker detects

$$R_{FDC_{(1d)}} = A_{DJ} \cdot A_{ECMA_{(id,1d)}}$$

where

$R_{FDC_{(1d)}}$ = defender reduction of detection and conversion on attackers

$A_{ECMA_{(id,1d)}}$ = ECM effect on defender

$$R_{FDC_{(1a)}} = 1$$

where

$R_{FDC_{(1a)}}$ = attacker reduction of detection and conversion on defenders

These reduction factors, R_F and R_{FDC}, are returned to AIR2AIR to reduce radar signals, simulating jamming.

B.3 SUBROUTINE ASAM

SHORAD & Terminal SAMs are dispersed with a density A_{DENS} over an area whose boundaries are R_{SAMS}/R_{SAMA}, the standoff range of these defenses, and R_P, the range that the attacker penetrates into this defensive zone. R_P may be either the partial penetration of the attacker into this zone or the standoff distance of the next zone. For any group of attackers entering this zone, there is an area of exposure described by both their path length (R_P-R_S) and the maximum effective range of the SAMs, or R_{DSAM}. This area of exposure is

$$A_E = (R_P - R_S) \cdot 2 \cdot R_{DSAM}$$

Multiplying this area A_E by the average SAM site density, A_{DENS}, yields the number of sites expected to be encountered during the flight through this zone. The inverse of this product is the incremental distance that the group will encounter one site, or

$$D_{RSS} = 1/(A_E \cdot A_{DENS})$$

Upon encountering a SAM site, the group has a probability of survival P_S dependent upon the number of SAMs fired. If the group size is small, representing a "target poor" environment for the SAMs, then the expected number of salvos launched, X_{NSE}, is dependent on the aircraft probability of survival between each successive salvo of a multiple shoot-look-shoot capable SAM launch vehicle. For example,

P_1 = Probability of first shot = 1

P_2 = Probability of second shot

= 1 - Probability of kill of first shot

= $1-P_{KSALVO}$

etc., until

$$X_{NSE} = P_1+P_2+P_3 \dots P_{NSLS}$$

$$X_{NSE} = 1+(1-P_{KSALVO})^1+(1-P_{KSALVO})^2+ \dots +(1-P_{KSALVO})^{N_{SLS}-1}$$

$$= \sum_{i=0}^{N_{SLS}-1} (1-P_{KSALVO})^i$$

$$X_{NSE} = \sum_{i=1}^{N_{SLS}} (1-P_{KSALVO})^{i-1}$$

where N_{SLS} is the number of shoot-look-shoots per launch vehicle.

Should the environment be target poor, X_{NSE} is simply the ratio of all potential SAM salvos to all aircraft, or

$$X_{NSE} = N_{SAM} \cdot N_{SAML} / X_{NATOT}$$

where

N_{SAM} = number of salvo launchers/launch vehicle

N_{SAML} = number of launch vehicles/SAM site

X_{NATOT} = Total number of aircraft

Then, the probability of survival for the attacking aircraft, P_S, is

$$P_S = (1 - P_{KSALVO})^{N_{XNSE}} \cdot (1 - P_{KSALVO} \cdot (X_{NSE} - N_{XNSE}))$$

where N_{XNSE} = integer portion of the expected number of salvos

The expected number of aircraft emerging from this encounter is therefore

$$X_{NA} = X_{NATOT} \cdot P_S$$

B.4 SUBROUTINE BSAM

Barrier SAMs, typically the second zone of defense in AIRWAR II, are dispersed in a line parallel to the FEBA. Each SAM site is located some distance D_{SAM} from the next and has a range of R_S. Thus, the exposure to SAM sites that a group of attackers will experience is

$$\alpha = 2 \cdot R_{DSAMB}/D_{SAM}$$

The expected number of shots per aircraft is the total number of missiles the aircraft are exposed to divided by the total number of aircraft, or

$$X_{NSE} = X_{NS} \cdot N_{SAML} \cdot \alpha / X_{NATOT}$$

where

X_{NS} = minimum of either launchers or missiles per launch vehicles

N_{SAML} = number of launch vehicles per SAM site

X_{NATOT} = expected number of attackers, total, to enter this defensive zone.

This assumes all missiles are launched.

If, however, the ratio of SAMs to aircraft is such that the SAMs are presented with a target poor environment, then SAMs with multiple shoot-look-shoot capability will conserve resources dependent upon their success in depleting aircraft. Thus, the expected number of salvos

$$X_{NSE} = \sum_{i=1}^{N_{SLS}} (1 - P_K)^{i-1}$$

where

P_K = probability of kill per SAM salvo

N_{SLS} = number of shoot-look-shoot opportunities of the SAM launch vehicles

With the determination of the minimum X_{NSE}, the expected number of aircraft to emerge from the SAM zone is

$$X_{NA} = X_{NATOT} \cdot P_S$$

where

$$P_S = (1 - P_K)^{N_{XNSE}} \cdot (1 - P_K \cdot (X_{NSE} - N_{XNSE}))$$

N_{XNSE} = Integer portion of the expected number of SAM salvos

B.5 SUBROUTINE AIR 2 AIR

Subroutine AIR 2 AIR supervises an air battle between Red and Blue forces, each force with a possibility of six different aircraft types, firing three different salvo types. Boundary conditions are defined in this routine, enabling subroutine A2A to fight the actual salvo-by-salvo battle matrix.

The initial number of aircraft participating in this battle are summed for each side and the mean probability of fratricide for each aircraft type is calculated.

$$X_{NRSUM} = \sum_{ij=1}^{6} X_{NRD(ij)}$$

where

X_{NRSUM} = total Red aircraft at battle

X_{NRD} = number of aircraft of each type of Red present at battle

$$P_{FRM(ij)} = \frac{\sum_{j=1}^{6} P_{FR(ij,j)} \cdot X_{NRD(j)}}{X_{NRSUM}}$$

where

P_{FRM} = mean probability of fratricide during this battle

P_{FR} = probability of fratricide (Red on Red)

j = aircraft type

ij = aircraft type

Although equations shown here are for Red, the corresponding equations are evaluated for Blue.

Boundary conditions of the battle matrix are defined, and the fight begins— all types of Red versus all types of Blue.

Subroutine ECM supplies two reduction factors for this type-to-type confrontation, one for the number of detections per engagement, the other for detection and conversion. This limits each side to fighting only those adversaries which are known and seen. Ranks of each side are further thinned by fratricide before adversaries are distributed to each other, assuming uniform distribution.

$$X_{NRI} = X_{NRD(i)} \cdot (1 - P_{FRM(i)}) \cdot \frac{X_{NBD(j)}}{X_{NBSUM}}$$

where

X_{NRI} = number of Red aircraft distributed to each Blue

X_{NBD} = number of Blue aircraft of type j

X_{NBSUM} = total number of Blue aircraft in this battle

$$X_{NR(0,0)} = X_{NRI} \cdot R_{F(1)}$$

where

$X_{NR(0,0)}$ = initial number of Red, considering jamming

$R_{F(1)}$ = reduction factor of number detections due to jamming

A higher probability of kill exists for multiple shot salvos.

$$P_{KR_{(kl)}} = 1 - (1 - P_{KSSR(i,kl)})^{M(i,kl)}$$

where

P_{KR} = probability of kill for multiple shot salvo

P_{KSSR} = probability of kill for single shot

$M_{(i,kl)}$ = number missiles per salvo

i = Red aircraft type

kl = missile type

Subroutine A2A now processes the battle matrix, plane-on-plane, salvo by salvo. Survivors are summed by type for each side.

$$X_{NRSE(i)} = \sum_{i=1}^{6} X_{NRS} + X_{NRI}(1 - R_{F(1)})$$

where

X_{NRSE} = Red survivors

X_{NRS} = number of survivors determined by A2A

$X_{NRI}(1 - R_{F(1)})$ = Red aircraft not seen or shot at because of jamming

i = Red aircraft type

Adversaries having taken their toll of each other's aircraft, fratricide further thins the ranks of survivors. These calculations of Red on Red and Blue on Blue differ little in method from Red on Blue. Red variables are again loaded with Red attacker data and former Blue variables are loaded with Red victim data.

$$X_{NR(0,0)} = 1/2 \cdot X_{NRD(i)} \cdot P_{FRM(i)} \left(\frac{X_{NRD(i')}}{X_{NRSUM}} \right)$$

where

$X_{NR(0,0)}$ = initial number of Red

$X_{NRD(i)} \cdot P_{FRM(i)}$ = number of Red aircraft of type i who attack their own side

$\frac{X_{NRD(i')}}{X_{NRSUM}}$ = relative fraction of Red being shot at

The factor 1/2 is included to enable passing twice through the code, as was done with Red on Blue, since now the battle is Red on Red. As fratricide assumes that mistaken identity prevails throughout the battle, no probability of identification is considered.

$$P_{DRBD_{(k1)}} = P_{DRR_{(i,i')}}$$

where

P_{DRBD} = probability of detect/convert, correct ID

$P_{DRR_{(i,i')}}$ = probability of detect/convert Red type i on Red type i'

k1 = missile type

After A2A conducts the battle, Red survivors are summed for type i and type i'.

Blue fratricide follows a similar path. Total Red and Blue survivors, by aircraft type, are returned to BATTLE.

B.6 MAINTENANCE VARIABLES

For primary and secondary bases of Red and Blue and for all six aircraft types, these maintenance variables are set up in subroutine READIT from input values.

For primary bases:

$$D_{MD} = D_{MTTR(ij,id)}$$

$$F_{MD} = F_{MTTR(ij,id)}$$

$$F_S = 1 - F_{A(ij,id)}$$

where:

D_{MTTR} = mean time to repair damaged aircraft

F_{MTTR} = mean time to repair failed (broken) aircraft

F_S = specific fraction of aircraft at base being evaluated

F_A = fraction of aircraft stationed at secondary bases at time $t = 0$.

ij = aircraft type

id = identification: 1, Red; 2, Blue

For secondary bases:

$$D_{MD} = \frac{D_{MTTR(ij,id)}}{F_{OP(id)}}$$

$$F_{MD} = \frac{F_{MTTR(ij,id)}}{F_{OP(id)}}$$

$$F_S = F_{A(ij,id)}$$

where:

F_{OP} = fraction of operability at which secondary bases operate relative to primary bases

Repair queues later in the game need to know how many damaged and broken planes can be repaired in one game time step. That number is calculated as a fraction of a plane which can be repaired.

$$P_{REP1_{(ij,id,ips)}} = 1 - \exp\left(\frac{-D_T}{F_{MD}\left(1 + C_{NBF_{(id)}}\right)}\right)$$

$$P_{REP2_{(ij,id,ips)}} = 1 - \exp\left(\frac{-D_T}{D_{MD}\left(1 + C_{BNF_{(id)}}\right)}\right)$$

where:

P_{REP1} = fraction of a broken plane which can be fixed in one DT

P_{REP2} = fraction of a damaged plane which can be fixed in one DT

D_T = time increment of this game

C_{BNF} = fractional increase in repair and turnaround time due to chemical, biological or nuclear attacks, constant

ips = base index: 1, primary; 2, secondary

Total time for a given aircraft to fly to battle and back is calculated.

$$T_{MISSN} = 2 \cdot \frac{R_{B_{(ij,id,ips)}} + R_{P_{(ij,id,ips)}}}{V_{(ij,id)}}$$

where:

T_{MISSN} = time for a mission of this aircraft

R_B = distance from attacker's base to FEBA

R_P = distance of penetration behind FEBA

V = velocity of aircraft

The resulting mission time is used to determine the probability of a failure free mission.

$$P_{AOK(ij,id,ips)} = \exp\left(\frac{-T_{MISSN}}{X_{MTBF(ij,id)}}\right)$$

where:

P_{AOK} = probability of no failure during mission

X_{MTBF} = mean time between failures

The failure free rate also implies a failure rate.

$$Q_{AOK(ij,id,ips)} = 1 - P_{AOK(ij,id,ips)}$$

where:

Q_{AOK} = probability of failure during mission

Aircraft which are hit by enemy action may or may not be damaged beyond repair.

$$Q_{DBR(ij,id)} = 1 - P_{DBRP(ij,id)}$$

where:

Q_{DBR} = probability that a hit is not damaged beyond repair

P_{DBRP} = probability that a hit is damaged beyond repair

From among the aircraft which are stationed at each base, a number are found to be ready for flight.

$$R_{EADY(ij,id,ips)} = \left(P_{RDY(ij,id)}\right) A_{CRFT(ij,id)} F_S$$

where:

R_{EADY} = number of type ij aircraft ready at id's ips base

P_{RDY} = fraction of aircraft ready at start

A_{CRFT} = initial total number of type ij aircraft owned by id

F_S = fraction of id's aircraft at base ips

Aircraft which are able to fly, but are not yet ready, are placed in reserve.

$$R_{ESERV_{(ij,id,ips)}} = \left(1. - P_{RDY_{(ij,id)}}\right) A_{CRFT_{(ij,id)}} F_S$$

where:

R_{ESERV} = all able aircraft not ready

The number of turnarounds for each aircraft type of each side at both primary and secondary bases is initialized.

$I_{TN_{(ij,id,ips)}}$ = initial number of turnarounds, set to 1.

The number of game time steps to complete turnaround for each aircraft type of each side at both bases is calculated.

$$N_{ITN_{(ij,id,ips)}} = \text{integer of} \left(\frac{T_{AT_{(ij,id,ips)}}\left(1. + C_{BNF(id)}\right)}{D_T} + .5\right)$$

where:

N_{ITN} = number of DT's to complete turnaround

T_{AT} = turnaround time of type ij aircraft at id's ips base

Within subroutine QEVNT, turnaround of aircraft takes place as game time advances.

At each time step that planes are assigned to turnaround, an index is computed dependent upon $N_{ITN_{(ips)}}$, the number of time steps to turnaround this particular aircraft.

The indices are so constructed that these aircraft cannot be accessed (taken out of turnaround) until $N_{ITN_{(i,id,ips)}}$ time steps have passed.

The function to calculate turnaround index is as follows:

MODN(I,N) = 1 + MOD(N+MOD (I - 1,N),N)

where:

$MODN$ = the index returned

I = first argument

N = second argument

MOD = system function; integer remainder

At each time step, the current index points to planes completing turnaround. Then a new index is computed for use in the next time step.

$$I_{TN(i,id,ips)} = MODN\left(I_{TN(i,id,ips)} + 1,\ N_{ITN(i,id,ips)}\right)$$

where:

I_{TN} = index for next time step

$I_{TN}+1$ = number of current index plus one (to get next index)

i = aircraft type

id = identification: 1, Red; 2, Blue

ips = base index: 1, primary; 2, secondary

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